Austin Energy DSM
Market Potential Assessment

Final Report

Prepared for
Austin Energy
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Glossary

achievable potential: The amount of savings that would occur in response to specific program funding and measure incentive levels. Savings associated with program potential are savings that are projected beyond those that would occur naturally in the absence of any market intervention.

applicability factor: The percentage of the building stock that has a particular type of equipment or for which an efficiency measure applies. For example, the applicability factor for a tankless electric water heater (compared to a base standard electric water heater) is the percentage of homes with electric water heaters. The applicability factor for high-efficiency clothes washers as an electric water heating measure is the percentage of homes with electric water heating that also have a clothes washer. For base measures, this is sometimes referred to as the equipment saturation.

business-as-usual (BAU): Represents a continuation of current activities or trends. For utility programs, it denotes a scenario in which program marketing and administrative budgets are kept constant in real terms, and incentive levels are kept constant as a percentage of incremental costs.

baseline analysis: Characterizes how energy consumption breaks down by sector, building type, and end use.

base measure: The equipment against which an efficiency measure is compared.

C&I: commercial and industrial.

CFL: compact fluorescent lamp.

coincidence factor: Utility coincidence factors are the ratio of actual demand at utility peak to the average demand, as calculated from the load shape. These factors vary by market segment or building type, end use, and by time-of-use period.

cumulative annual: Savings occurring in a particular year that are due to cumulative program activities over time. For example, if a program installs one high-efficiency widget in year 1 of the program, two in year 2, and five in year 3, the cumulative annual savings in year three would be the savings accruing on all eight surviving units in place in year 3, regardless of what year they were installed. Cumulative annual savings does account for equipment retirement. In the example above, widgets are assumed to have an effective useful life of more than three years. If the equipment in the above example were doohickeys, which only have a two-year effective useful life, the year 1 doohickey would have retired at the end of year 2, so only the units sold in years 2 and 3 would contribute to year 3 cumulative annual savings.

demand-side management (DSM): An electric system must balance the supply of electricity with the demand for electricity. Demand-side management (DSM) programs focus on managing the demand side of this balance through energy-efficiency and load management.

Energy Conservation Audit and Disclosure Ordinance (ECAD): The city of Austin requires owners of single-family homes to have an energy audit performed on their home prior to selling that home per this ordinance.

economic potential: The technical potential of those energy conservation measures that are cost effective when compared to supply-side alternatives.

effective useful life (EUL): A measure of the typical lifetime of an efficiency measure. Technically, it is the age at which half of the units have failed and half survive. In DNV KEMA's ASSYST™ model, all measures are assumed to remain in place until the end of their effective useful lives and then retire.

end-use energy intensity (EUI): Energy use per unit of building stock having a specific end use. For example, the EUI for commercial electric heating is the amount of electricity used for heating divided by the number of square feet of floor space that are electrically heated. EUI differs from EI in that it accounts for the equipment type's saturation. If the saturation of the equipment type is low, the EUI will be much higher than the EUI.

energy intensity (EI): Energy use per unit of building stock. For example, the EI for commercial electric heating is the amount of electricity used for heating divided by the total square feet. EI differs from EUI in that it does not account for the saturation of the equipment. If the saturation for the equipment type is low, EI will be much lower than the EUI.

EUI adjustment factor: Because equipment efficiencies can change over time independent of program activities, due to either naturally occurring technological changes or external intervention, such as appliance standards, the efficiency of new equipment may differ from the typical efficiency of the equipment stock. The EUI adjustment factor is the ratio of new standard efficiency equipment's energy use to the average energy use of units in the equipment stock.

feasibility factor: The fraction of the applicable floor space, or households, that is technically feasible to convert to a DSM technology, from an engineering perspective.

free rider: A program participant who would have invested in an energy efficiency measure even without the intervention of the program. Free riders add to program costs but do not contribute to net energy savings.

free-rider energy savings: The subset of naturally occurring energy savings for which the utility pays incentives or provides other program benefits. These savings are included in gross program savings but not in net program savings.

gross program savings: The total savings for all measures installed under the program, including those that would have been installed even without program intervention (free riders). Gross program savings equals net program savings minus free ridership.

HP: horsepower. A metric for the power of a motor.

HVAC: heating, ventilation and air conditioning. These space-conditioning measures are often discussed as a group and are referred to by the abbreviation HVAC, usually pronounced H-vac.

incomplete factor: The fraction of the applicable floor space, or households, that has not yet been converted to the particular energy-efficiency technology.

incremental cost: The additional cost required to purchase an efficiency measure compared to base equipment.

kW: kilowatts, 1,000 watts. A measure of electric power or electricity demand.

kWh: kilowatt-hour. A measure of electrical energy.

LED: light-emitting diode. LEDs are semiconductor light sources. They have been in use for decades as indicator lights; they are increasingly being used for general-purpose lighting. They are highly efficient compared to incandescent lamps.

line losses: When electricity is transmitted over the transmission and distribution system, some of the electricity is dissipated as heat due to resistance in the transmission lines or inefficiencies in transformers in the distribution system. As a result, the amount of electricity delivered to consumers is less than the amount produced at the generator. These are referred to as line losses or transmission and distribution losses.

load management: Load management refers to methods that control the power demand within an electric system. Load management programs are designed to reduce the electrical demands during time of system peak energy use (in contrast to energy efficiency programs that focus on reducing overall energy use, and may or may not reduce energy use during peak hours). Examples of load management programs include air conditioner cycling and thermal energy storage.

MW: megawatt, one million watts. A measure of electric power or electricity demand.

MWh: megawatt-hour, equal to 1,000 kWh. A measure of electrical energy.

naturally occurring energy savings: The amount of savings estimated to occur as a result of normal market forces, that is, in the absence of any utility or governmental intervention.

net program savings: Program savings above and beyond naturally occurring levels. Net savings exclude free-rider energy savings.

net-to-gross: The ratio of net program savings to gross program savings.

program potential: This term is used interchangeably with achievable potential.

replace on burnout (ROB): A measure that is installed when the previous equipment reaches the end of its useful life. ROB measures penetrate the market gradually as the existing stock of equipment turns over due to equipment age and eventual failure.

retrofit: A measure that is installed to achieve energy savings independent of the condition of the existing equipment. This includes measures that affect the energy use of other equipment, such as insulation to reduce heating costs. It also includes replacing equipment with higher efficiency equipment before the end of existing equipment's useful life, for example replacing T12 fluorescent lighting in an office with higher efficiency T8s. Retrofits can be done at any time and therefore have the potential to penetrate the market more quickly than ROB measures.

spinning reserves: Operating reserve is the generating capacity available to an electricity network operator within a short interval of time to meet demand in case of a disruption to electricity supply. Spinning reserve is the share of operating reserve that is available by increasing the power output of generators already connected to the power system. Spinning reserves help ensure stability of the electricity network in case of an unexpected event, such as a generator going down or unforeseen load swings.

technical potential: The savings that would result from complete penetration of all analyzed measures in applications where they were deemed technically feasible, from an engineering perspective.

technology saturation: A factor that relates the cost units used in the model for a measure to its savings units. For example, the cost of a chiller may be expressed in dollars per ton, though the savings are in kWh per square foot. The technology saturation then represents the number of tons of cooling per square foot.

time-of-use (TOU) period: The Assyst model can analyze energy use by up to six time-of-use periods. These periods are used to characterize the relationship between energy and peak demand, which varies over both season and time of day, and to capture differences in avoided costs and rates over different time periods. TOU periods usually capture differences between summer/winter and peak/off-peak but can also capture shoulder season, mid-peak, or super peak demand, depending on the needs of a utility.

transmission and distribution (T&D): This refers to the system of power lines that delivers electricity from the generator to the customer.

transmission and distribution (T&D) losses: See line losses.

total resource cost test (TRC): A benefit-cost test that compares the value of avoided energy production and power plant construction to the costs of energy efficiency measures and the program activities necessary to deliver them. The values of both energy savings and peak-demand reductions are incorporated in the TRC test.

1. Executive Summary

In 2007, the city of Austin adopted the Austin Climate Protection Plan (ACPP) to build a more sustainable community. Austin Energy established a demand savings goal of 800 MW by 2020, of which 269 MW has been achieved through program efforts from 2007 through 2011. To meet its goal, Austin Energy must capture an additional 531 MW of savings from current and future DSM efforts. Of that 531 MW, Austin Energy expects 236 MW to be captured from load management and building codes and 295 MW to be captured from energy efficiency programs.

Austin Energy engaged DNV KEMA Energy & Sustainability (DNV KEMA) (operating as KEMA, Inc. at the time) to assess the potential for electric energy (kWh) and demand (kW) savings through 2020 from company-sponsored energy-efficiency programs. The assessment produced:

- Estimates for the magnitude of potential savings on an annual basis under a range of program design scenarios
- Estimates of the costs associated with achieving those savings
- Calculations of measures and programs' cost-effectiveness based on the estimates above.

1.1 Scope and Approach

In this study, DNV KEMA estimated three basic types of energy efficiency potential using its proprietary DSM ASSYST™ model:

- **Technical potential,** defined as the complete penetration of all analyzed measures in applications where they were deemed technically feasible, from an engineering perspective
- **Economic potential,** defined as the technical potential of those energy efficiency measures that are cost-effective when compared to supply-side alternatives
- **Achievable program potential,** the amount of savings that would occur in response to specific program funding, marketing, and measure incentive levels.

DSM ASSYST™ also develops an estimate of naturally occurring savings, those savings that are projected to result from normal market forces in the absence of any utility-sponsored intervention. These savings are not included in the estimate of achievable program potential.

The model uses a bottom-up approach in which energy efficiency costs and savings are assessed at the customer segment and energy efficiency measure level. Technical and economic potential are estimated as a function of measure savings, equipment saturation, and existing penetration of efficiency measures. Economic potential takes into account measure costs and includes only those measures that are cost effective based on the total resource cost, or TRC, test. Program savings potential is estimated for cost-effective measures based on measure economics, rebate levels, and program marketing and education efforts.

For this study, DNV KEMA constructed four different program funding scenarios to estimate Austin Energy's achievable energy efficiency potential. The first scenario, the business-as-usual (BAU) scenario, projects the current program design and implementation features across the forecast horizon. Once calibrated, the model produces outputs closely aligned with the known program savings results from the most recent program. This approach ensures that the model, to the extent possible, can appropriately represent reality using a set of known conditions.

DNV KEMA estimated program results under three additional incentive scenarios using the calibrated model. One scenario was the same as the BAU scenario except that marketing budgets were kept flat over time instead of increasing with inflation as in the BAU scenario. The second scenario allowed for incentives that covered 75 percent of incremental measure costs. In the final scenario, incentives covered 100 percent of incremental measure costs. Program marketing costs were scaled upward in the 75- and 100- percent incentive scenarios to reflect increasing program effort, and program administration costs were adjusted across scenarios proportionate to achievable program energy savings. These scenarios are referenced respectively as BAU Flat Budget, 75-percent Scenario, and 100-percent Scenario. Program energy and peak-demand savings and program cost-effectiveness were assessed under all funding scenarios.

Study results are estimates of energy and demand savings potential based on certain program assumptions. The study can be used to help target measures and customer segments for DSM programs and, by resource planners, to determine to appropriate mix of demand-side and supply-side resources. The study does not attempt to provide estimates of optimal levels of DSM activity but rather provides estimates of the savings possible at various levels of effort.

The scenarios shown in this study are also fairly broad-brush, showing potentials for incentive rates that vary by scenario but are constant for all measures within a scenario. We expect that Austin Energy will adjust incentives and related program expenditures on a measure-by-measure basis to reflect differences within markets and to enhance the amount of savings that are achievable within limited program budgets. We also expect that Austin Energy will adjust its efforts over time since some measures may eventually saturate the market.

1.2 Results

In Table 1-1, we present the DSM potential study's overall results. The table shows base energy use, Austin Energy's DSM program cumulative savings forecast from 2012 to 2020, DNV KEMA's estimates of technical and economic potential, and DNV KEMA's cumulative results from 2012 to 2020 for all four achievable potential scenarios. Austin Energy's no-DSM base forecast is 3,963 MW in 2020. Austin Energy forecasts 236 MW of demand savings from load management programs and building code changes from 2012 to 2020. Since this study focused on energy efficiency in new and existing buildings and did not address potential for load management or building codes, the base forecast for this study is 3,727 MW (Austin's no-DSM forecast minus the 236 MW from out-of-analysis programs).

To put the energy efficiency potentials in the context of Austin Energy's overall programs, the table includes a row for total DSM savings that includes energy efficiency and the estimated 236 MW of savings for load management and building codes. These can be compared to the 531 MW that remain to be captured of Austin Energy's 800 MW 2020 goal.

The BAU case falls short of Austin Energy's 2020 forecast. This is primarily due to diminishing retrofit opportunities over time as more of the market converts to high efficiency technologies, which result in savings growing more slowly in later years than in early forecast years. However, the potential at the 75-percent incentive level significantly exceeds Austin's forecast (by 24 percent). We estimate that incentives between 55 and 60 percent of incremental costs would be sufficient to meet Austin Energy's current goals.

In the 100-percent incentive scenario, we estimate that Austin Energy's DSM programs could reduce demand by 727 MW by 2020. Considering the 269 MW Austin Energy estimates that its programs have already saved from 2007 to 2011, the total savings in 2020 would be 996 MW.

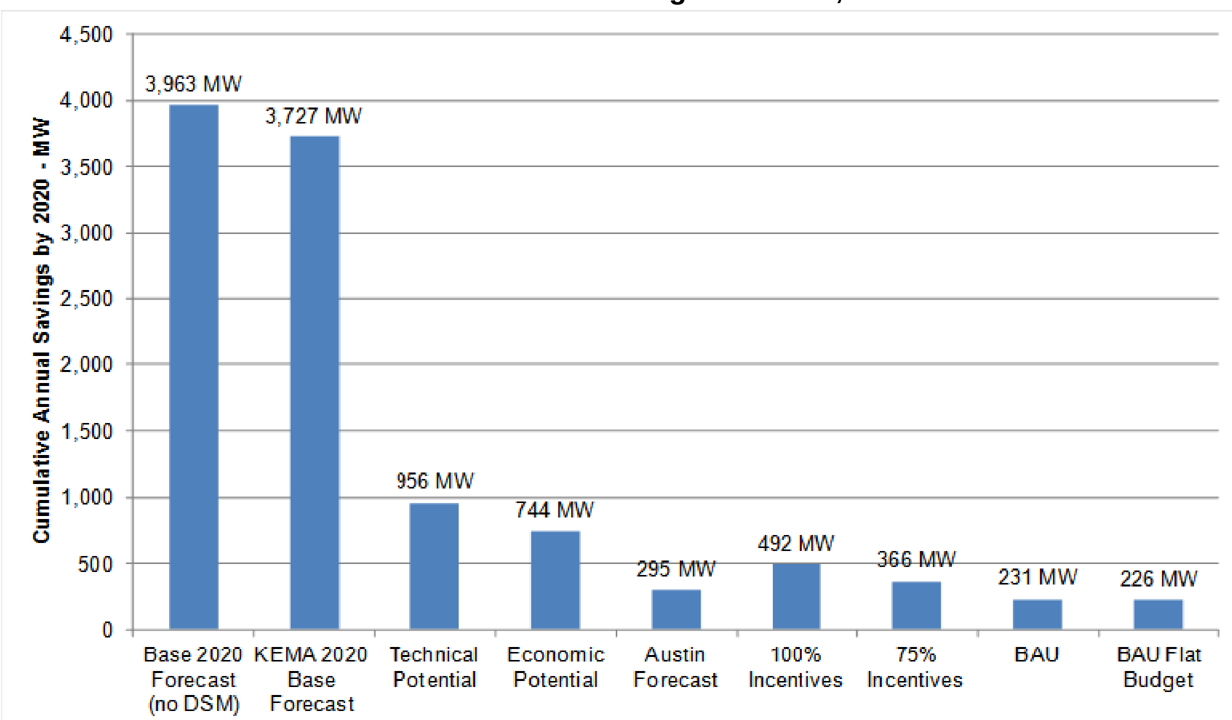
Table 1-1
Summary of Cumulative DSM Potentials—2012–2020

	Base 2020 Forecast	Austin Energy Program Savings Forecast	DNV KEMA Potential Estimates					
					Achievable Potentials			
			Technical Potential	Economic Potential	BAU Flat Budget	BAU	75 Percent Incentives	100 Percent Incentives
Base 2020 Forecast (No DSM)	3,963							
Out-of-analysis AE Program Savings Forecast		236						
KEMA Base 2020 Forecast	3,727							
Residential Total	1,482	133	636	509	106	107	182	254
Commercial Total	1,477	162	349	276	94	97	146	189
Industrial Total	518		84	70	26	27	37	48
Other Total	250		0	0	0	0	0	0
All Sectors Total (EE)	3,727	295	956	744	226	231	366	492
Savings % of KEMA Base		7.9%	25.7%	20.0%	6.1%	6.2%	9.8%	13.2%
Savings % of Austin No-DSM Base		7.4%	24.1%	18.8%	5.7%	5.8%	9.2%	12.4%
Savings % of Economic Potential		40%			30%	31%	49%	66%
Total DSM (in and out of KEMA analysis)		531	1,192	980	462	467	602	727
Savings % of Austin No-DSM Base		13.4%	30.1%	24.7%	11.7%	11.8%	15.2%	18.4%

Notes: Base peak demand (no DSM) is Austin Energy's forecast assuming the absence of DSM programs. Out-of-analysis savings include Austin Energy's forecasted savings from load management programs and Austin's building codes. DNV KEMA's 2020 base forecast is net of the load management and code savings. The *All Sectors Total* (EE) row excludes the out-of-analysis savings, while the *Total DSM* row includes those savings (236 MW). The demand forecast includes 20 percent for transmission and distribution and spinning reserves.

Figure 1-1 summarizes the 10-year peak-demand savings potential estimates. We estimated technical potential at 956 MW and economic potential at 744 MW. Achievable program potential ranges from a high of 492 MW under the 100-percent incentive case to 226 MW under the BAU flat budget case (Austin Energy's forecast is 295 MW). Economic potential for peak demand savings is estimated to be 21 percent of base 2020 peak demand; achievable potentials range from 13 percent of base peak demand under the 100-percent incentive case to 6 percent of base peak demand under the BAU flat budget case. All results include line losses and a factor for spinning reserves.

Figure 1-1
Estimated Peak-demand Savings Potential, 2012–2020



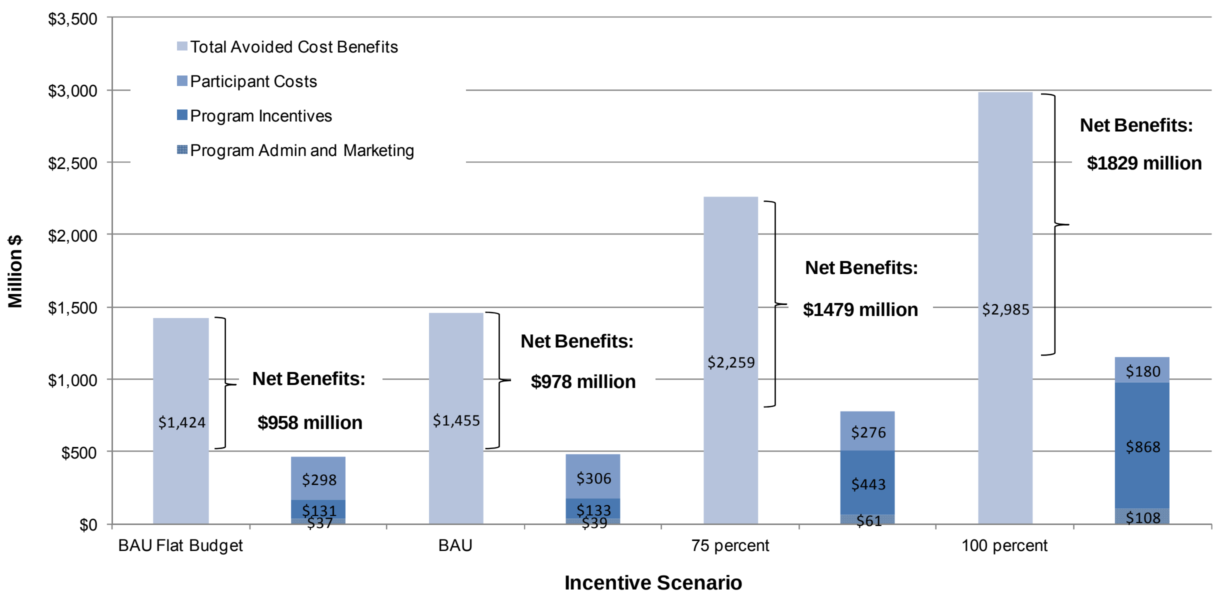
Notes: Base peak demand (no DSM) is Austin Energy's forecast assuming the absence of DSM programs. DNV KEMA's 2020 base forecast accounts for the effects of load management programs and Austin's building codes that are not modeled in this analysis, using Austin Energy's savings forecasts for those programs. Austin Energy's forecast includes savings from energy efficiency in existing and new buildings but excludes load management and code savings. The demand forecast includes 20 percent for transmission and distribution and spinning reserves.

Figure 1-2 depicts the cumulative costs and benefits under each program funding scenario from 2012 to 2020. The present value of program costs (including administration, marketing, and incentives) is $181 million under the BAU scenario ($177 million if budgets remain flat), $530 million under the 75-percent incentive scenario, and $1,015 million under the 100-percent incentive scenario. The present value of total avoided-cost benefits is $1,455 million under the

BAU scenario, $1,424 million under the BAU flat budget scenario, $2,259 million under 75-percent incentives, and $2,985 million under 100-percent incentives. The present value of *net* avoided-cost benefits[1] is $978 million under the BAU scenario ($958 million if budgets remain flat), $1,479 million under 75-percent incentives, and $1,829 million under 100-percent incentives.

As a result of dramatically increasing incentive costs for higher incentive scenarios, increases in program costs outpace the increases in benefits as one moves to higher incentive scenarios. As modeled, all program participants receive the same incentives in a given scenario, even though some customers would have accepted lower incentives. (Note, there are participant costs in the 100-percent incentive scenario because some measures are modeled as education-only programs in all scenarios and because the DSM ASSYST model assumes that measures initially purchased with program incentives are later repurchased without program incentives if they burn out during the forecast period.)

Figure 1-2
Benefits and Costs of Electric Efficiency Savings—2012–2020*



* PV (present value) of benefits and costs is calculated for 2012–2020 program years using a nominal discount rate = 4 percent and an assumed inflation rate = 2.5 percent.

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[1] *Net* avoided-cost benefits. i.e., the difference between total avoided-cost benefits and total costs, which include participant costs in addition to program costs.

All four of the funding scenarios are cost-effective based on the TRC test, which is the test we used in this study to determine program cost-effectiveness. The TRC benefit-cost ratio is 3.05 for the BAU scenario (3.06 for the BAU flat budget scenario), 2.90 for the 75-percent incentive scenario, and 2.58 for the 100-percent incentive scenario. This indicates that program cost-effectiveness declines somewhat with increasing program effort, reflecting increased penetration of more measures with lower cost-effectiveness levels. Key results of our efficiency scenario forecasts from 2012 to 2020 are summarized in Table 1-2 .

Table 1-2
Summary of Achievable Electric Potential Results—2012–2020

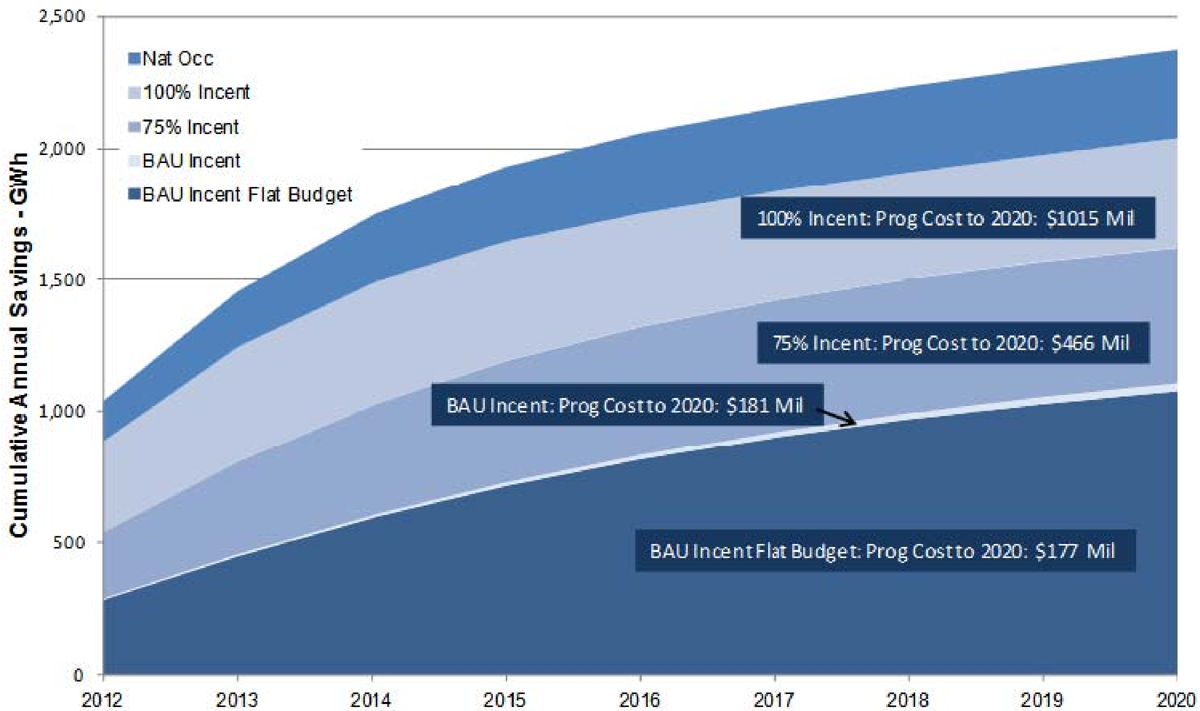
Result - Programs	Program Scenario:			
	BAU Incentives Flat Budget	BAU Incentives	75 percent Incentives	100 percent Incentives
Total Market Energy Savings - GWh	1,458	1,482	1,932	2,307
Total Market Peak Demand Savings - MW	291	295	422	541
Program Energy Savings - GWh	1,030	1,056	1,567	1,975
Program Peak Demand Savings - MW	226	231	366	492
Program Costs - Real, $ Million				
Administration	$19	$19	$41	$89
Marketing	$20	$22	$23	$24
Incentives	$138	$140	$466	$902
Total	$177	$181	$530	$1,015
PV Avoided Costs	$1,424	$1,455	$2,259	$2,985
PV Annual Program Costs (Adm/Mkt)	$37	$39	$61	$108
PV Net Measure Costs	$429	$439	$719	$1,048
Net Benefits	$958	$978	$1,479	$1,829
TRC Ratio	3.06	3.05	2.90	2.58

PV (present value) of benefits and costs is calculated for 2012–2020 program years using a nominal discount rate = 4 percent and an assumed inflation rate = 2.5 percent; GWh and MW savings are cumulative through 2020.

1.2.1 Achievable Savings Potentials over Time

Figure 1-3 shows estimates of achievable program potential energy savings over time. (Peak demand savings follow a similar pattern but are not shown.) Naturally occurring savings are also shown to provide a picture of total market potential. The figure shows that the rate of cumulative savings increase declines over time. This occurs because retrofit measures (measures that are not dependent on equipment turnover cycles and can be added at any time) reach high saturations over time, reducing the available pool for these opportunities and making it more difficult to capture additional savings. While the decline in additional savings is fairly modest under the BAU scenarios, it is more pronounced in the higher incentive cases. For the 100-percent incentive scenario, savings accumulate rapidly during the first few years of the forecast horizon but then flatten out thereafter. This can be perceived as a boom-bust phenomenon—a program ramps up dramatically over a few years and then must be scaled back significantly afterward as the program's participation declines due to high saturation levels. While the high-incentive scenario may lead to front-loaded energy savings, it could lead to dramatically reduced program effort and funding in later years, which may affect the program's ability to evolve and continue to capture emerging opportunities.

Figure 1-3
Achievable Electric Energy-Savings: All Sectors

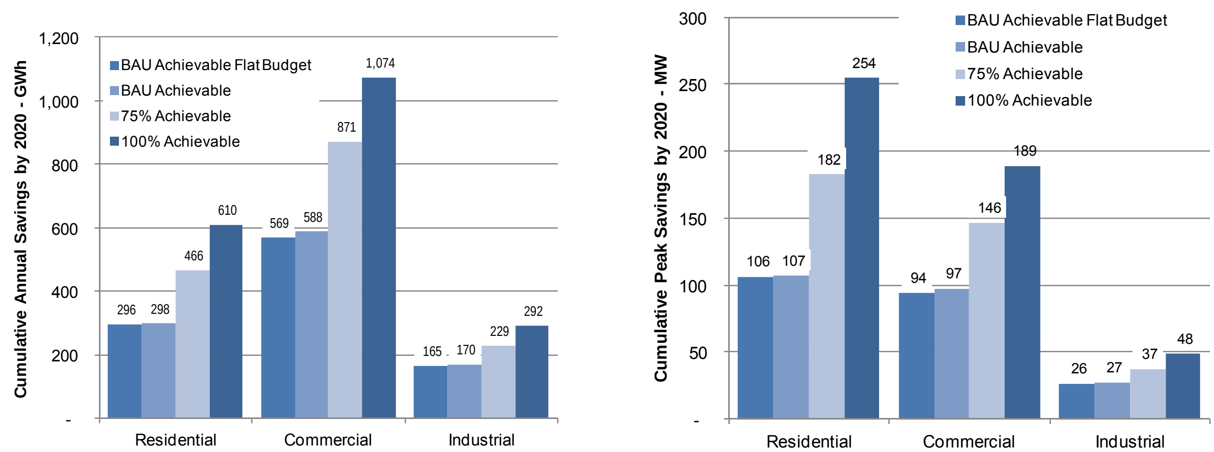


1.2.2 Base Energy Efficiency Results by Sector

Cumulative program savings potential estimates by customer class are presented in Figure 1-4 for the 2012–2020 period. The figure shows results for each funding scenario. Achievable program energy savings are highest for the commercial sector, but peak-demand savings are highest for the residential sector.

Figure 1-4
Net Program Achievable Energy Savings (2020) by Sector

Energy–GWh **Peak Demand–MW**



1.3 Conclusions

As the results of this study indicate, there is a significant amount of DSM potential remaining in Austin Energy's service territory. The residential and commercial sectors provide the largest sources of identified potential savings. While savings potentials in the industrial sector are lower, this segment is more complex and less understood that the other sectors, and our bottom-up analysis may understate, to some degree, all the custom energy efficiency opportunities available in this sector.

Our estimate of the savings under the BAU scenario is intended to show what can be saved with Austin Energy's current incentive levels and budgets. Although we matched Austin's budgets and savings closely in the forecast's early years, the model showed lower levels of savings in the forecast's later years. To a large extent, this result shows that Austin Energy could become a victim of its own success. As more of the market is converted to high efficiency, fewer and smaller opportunities remain for additional savings. This is particularly true of energy efficiency retrofits. The result of this effect can be seen in Figure 1-3 as the curve, which shows savings over time, flattens out in later years of the program.

Austin Energy may be able to offset this possibility through a number of approaches, for example by shifting program efforts away from saturated technologies toward technologies for which more opportunity remains. As emerging technologies enter the market or become more cost-effective, Austin may also find program opportunities there. However, while some savings could be achieved through low-cost strategic changes, it is likely that reaching its current 2020 goals will require offering higher incentives to attract hard-to-reach customers to the program, which will require higher program budgets.

One goal of this study was to provide data to determine whether Austin Energy's current Climate Protection Plan goal of 800 MW of demand savings by 2020 can be increased to 1,000 MW. We found that at 100-percent incentives, the program could achieve 996 MW by 2020, just shy of 1,000 MW. However, this represents an extreme level of program effort and would require a more than five-fold increase in program budgets compared to business-as-usual.

2. Introduction

2.1 Overview

Austin Energy retained DNV KEMA Energy & Sustainability (DNV KEMA) to conduct this demand-side management (DSM) market potential study, based on existing and proposed energy efficiency measures. The study provides estimates of potential electricity and peak-demand savings from energy efficiency measures in Austin Energy's service territory, including technical, economic, and achievable program potential. The study does not address savings from demand response programs, and it does not address natural gas equipment usage or savings.

The scope of this study includes new and existing residential and non-residential buildings as well as industrial process savings. The study covers a 9-year period spanning 2012–2020. Given the near- to mid-term focus, the base potential analysis was restricted to DSM measures that are presently commercially available.

Data for the study come from a number of different sources including internal Austin Energy studies and data, DNV KEMA's extensive energy efficiency database, and a variety of information from third parties.

2.2 Study Approach

This study involved identifying and developing baseline end-use and measure data and developing estimates of future energy efficiency impacts under varying levels of program effort.

We performed a baseline characterization that allowed us to identify the types and approximate sizes of the various market segments that are the most likely sources of DSM potential in Austin Energy's service territory. These characteristics then served as inputs to a modeling process that incorporated Austin Energy's energy-cost parameters and specific energy efficiency measure characteristics (such as costs, savings, and existing penetration estimates) to provide more detailed potential estimates.

To aid in the analysis, we utilized the DNV KEMA's DSM ASSYST™ model. This model provides a thorough, clear, and transparent documentation database and an extremely efficient data processing system for estimating technical, economic, and achievable potential. We estimated technical, economic, and achievable program potential for the residential, commercial, and industrial sectors, with a focus on energy efficiency impacts through 2020.

2.3 Background

In 2007, the city of Austin adopted the Austin Climate Protection Plan (ACPP) to build a more sustainable community. Austin Energy established a demand savings goal of 800 MW by 2020, of which 269 MW has been achieved through program efforts from 2007 through 2011. One of the goals of this potential study is to assess whether it is feasible to increase that goal from 800 MW to 1,000 MW.

Austin Energy has employed a number of different program efforts to reach its 800 MW goal. In addition to traditional utility DSM approaches such as energy-efficiency and load management, Austin Energy develops and enforces the city of Austin's building code. Since 2007, it has aggressively stepped-up code requirements to achieve 65 percent savings over the International Energy Conservation Code (IECC) 2006 for residential buildings by 2015 and to achieve a 30 percent savings for commercial buildings. The residential savings represented by the 2015 code is intended to be sufficient to achieve zero-net energy when combined with solar panels.

The city of Austin also has an Energy Conservation and Disclosure (ECAD) ordinance requiring that homeowners have an energy audit performed prior to selling their home. These audit results must then be provided to potential buyers. Although the ordinance does not require improvements to single-family homes, it provides motivation for sellers to correct energy deficiencies prior to sale and supplies information that buyers may act upon after sale. Austin Energy collects the results of the ECAD audits, which were made available to DNV KEMA as a data source for this study.

2.4 Layout of the Report

Section 3 of the report discusses the methodology and concepts used to develop the technical, economic, and achievable potential estimates. Section 4 provides baseline results developed for the study. Section 5 discusses the results of the electric energy efficiency potential analysis over time and by sector.

The report contains the following appendices:

- Appendix A: Detailed Methodology and Model Description—Further detail on what was discussed in Section 2.
- Appendix B: Measure Descriptions—Describes the measures included in this study.
- Appendix C: Economic Inputs—Provides avoided cost, electric rate, discount rate, and inflation rate assumptions used for the study.

- Appendix D: Building and TOU Factor Inputs—Shows the base household counts, square footage estimates for commercial building types, and base energy use by industrial segment. This appendix also includes time-of-use factors by sector and end-use.
- Appendix E: Measure Inputs—Lists the electric measures included in the analysis with the costs, estimated savings, applicability, and estimated current saturation factors.
- Appendix F: Non-Additive Measure Level Results—Shows energy-efficiency potential for each measure independent of any other measure.
- Appendix G: Supply-Curve Data—Shows the data behind the energy supply curves provided in Section 5 of the report.
- Appendix H: Achievable Program Potential—Provides the forecasts for the achievable potential scenarios.

3. Methods and Scenarios

This section provides a brief overview of the concepts, methods, and scenarios used to conduct this study. Additional methodological details are provided in Appendix A.

3.1 Characterizing the Energy Efficiency Resource

Energy efficiency has been characterized for some time as an alternative to energy supply options, such as conventional power plants that produce electricity from fossil or nuclear fuels. In the early 1980s, researchers developed and popularized the use of a conservation supply-curve paradigm to characterize the potential costs and benefits of energy conservation and efficiency. Under this framework, technologies or practices that reduced energy use through efficiency were characterized as “liberating ‘supply’ for other energy demands” and could therefore be thought of as a resource and plotted on an energy supply curve. The energy efficiency resource paradigm simply argued that the more energy efficiency or “nega-watts” produced, the fewer new plants would be needed to meet end-users’ power demands.

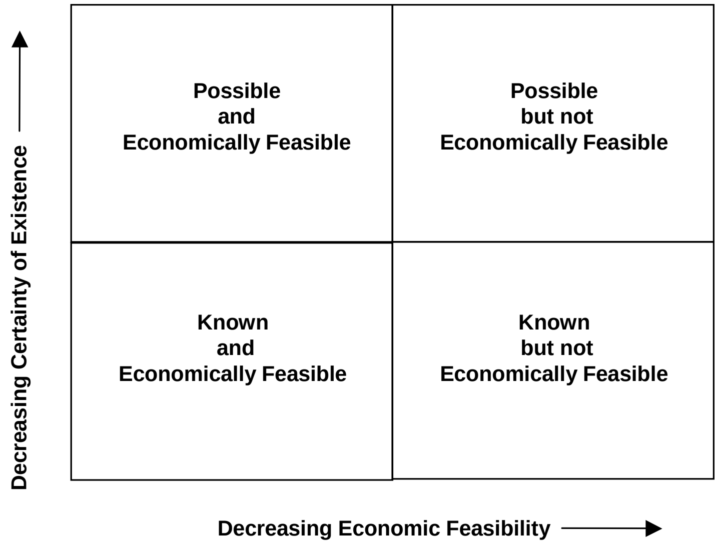
3.1.1 Defining Energy Efficiency Potential

Energy efficiency potential studies were popular throughout the utility industry from the late 1980s through the mid-1990s. This period coincided with the advent of what was called least-cost or integrated resource planning (IRP). Energy efficiency potential studies became one of the primary means of characterizing a resource’s availability and the value of energy efficiency within the overall resource planning process.

Like any resource, there are a number of ways in which an energy efficiency resource can be estimated and characterized. Definitions of energy efficiency potential are similar to definitions of potential developed for finite fossil-fuel resources, such as coal, oil, and natural gas. For example, fossil-fuel resources are typically characterized along two primary dimensions: the degree of geological certainty with which resources may be found and the likelihood that extraction of the resource will be economic. This relationship is shown conceptually in Figure 3-1.

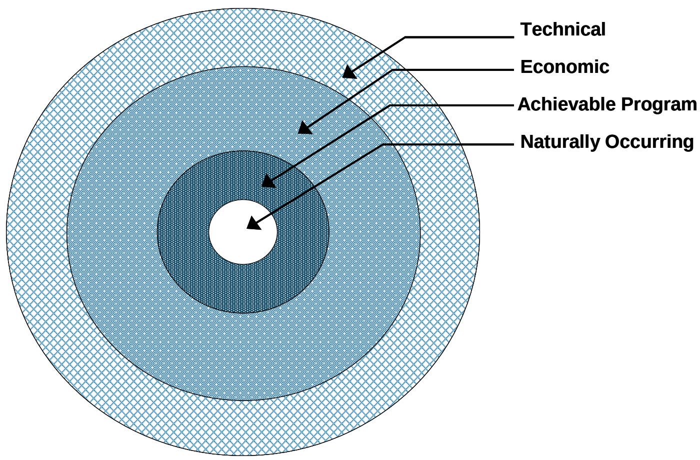
Somewhat analogously, this energy efficiency potential study defines several different *types* of energy efficiency *potential*, namely, technical, economic, achievable program, and naturally occurring. These potentials are shown conceptually in Figure 3-2 and are described below.

Figure 3-1
Conceptual Framework for Estimates of Fossil-fuel Resources



- **Technical potential** is defined in this study as the *complete* penetration of all analyzed measures in applications where they were deemed *technically* feasible from an *engineering* perspective.
- **Economic potential** refers to the *technical potential* of those energy conservation measures that are cost-effective when compared to supply-side alternatives.
- **Achievable program potential** refers to the amount of savings that would occur in response to specific program funding and measure incentive levels. Savings associated with program potential are savings that are projected beyond those that would occur naturally in the absence of any market intervention.
- **Naturally occurring potential** refers to the amount of savings estimated to occur as a result of normal market forces, that is, in the absence of any utility or governmental intervention.

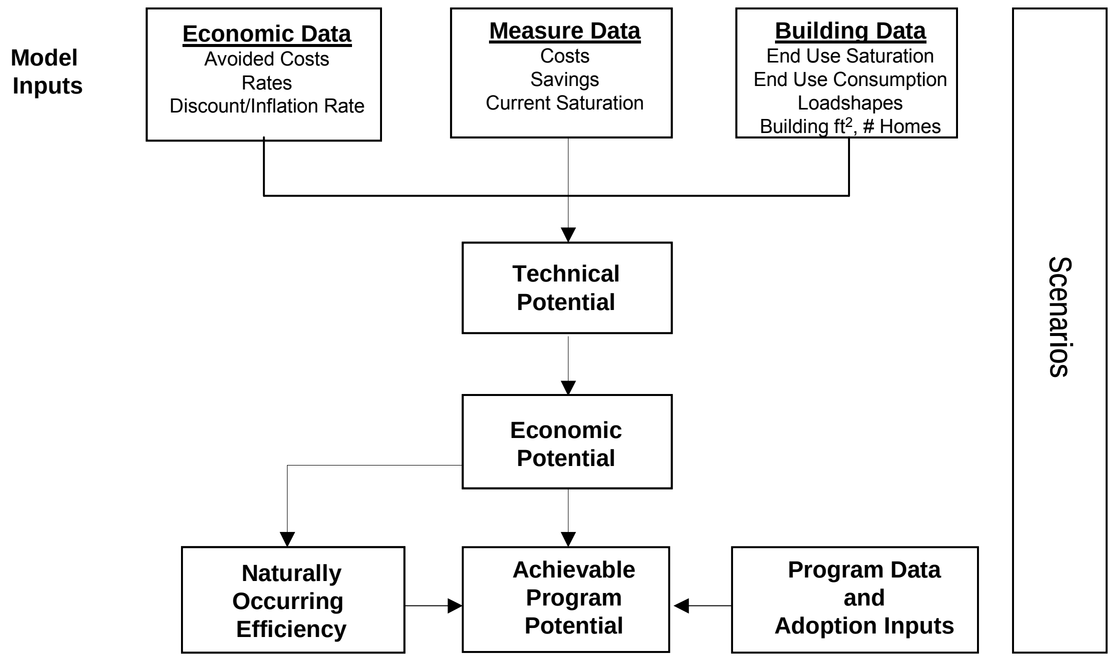
Figure 3-2
Conceptual Relationship between Energy Efficiency Potential Definitions



3.2 Summary of Analytical Steps Used

The crux of this study involves carrying out a number of basic analytical steps to produce estimates of the energy efficiency potentials introduced above. The basic analytical steps for this study are shown in relation to one another in Figure 3-3. The bulk of the analytical process for this study was carried out in a model developed by DNV KEMA for conducting energy efficiency potential studies. Details on the steps employed and analyses conducted are described in Appendix A. The model used DSM ASSYST, a Microsoft® Excel-based model, that integrates technology-specific engineering and customer behavior data with utility market saturation data, load shapes, rate projections, and marginal costs into an easily updated data management system.

Figure 3-3
Conceptual Overview of Study Process



In this study, the key steps implemented include:

Step 1: Develop Initial Input Data

- Develop a list of energy efficiency measure opportunities to include in scope. In this step, an initial draft measure list was developed and circulated internally within Austin Energy. The final measure list was developed after incorporating comments.
- Gather and develop technical data (costs and savings) on efficient measure opportunities. Measure data were gathered from a variety of sources. Measure descriptions are provided in Appendix B, and detail on measure inputs is provided in Appendix E.
- Gather, analyze, and develop information on building characteristics, including total square footage or total number of households, energy consumption and intensity by end use, end-use consumption load patterns by time of day and year (i.e., load shapes), market shares of key electric consuming equipment, and market shares of energy efficiency technologies and practices. Section 4 of this report describes the baseline data developed for this study.
- Collect data on economic parameters including avoided costs, electricity rates, discount rates, and inflation rate. These inputs are provided in Appendix C of this report.

Step 2: Estimate Technical Potential and Develop Supply Curves

- Match and integrate data on efficient measures to data on existing building characteristics to produce estimates of technical potential and energy efficiency supply curves.

Step 3: Estimate Economic Potential

- Match and integrate measure and building data with economic assumptions to produce cost indicators from different viewpoints (e.g., societal and consumer).
- Estimate total economic potential.

Step 4: Estimate Achievable Program and Naturally Occurring Potentials

- Screen initial measures for inclusion in the program's analysis. This screening accounted for factors such as cost-effectiveness, potential market size, non-energy benefits, market barriers, and potentially adverse effects associated with a measure. For this study, measures were screened using the total-resource-cost test while considering only electric avoided-cost benefits.
- Gather and develop estimates of program costs (e.g., for administration and marketing) and historic program savings.
- Develop customer adoption estimates for energy efficiency measures as a function of the economic attractiveness of the measures, barriers to their adoption, and the effects of program intervention.
- Estimate achievable program and naturally occurring potentials.

Step 5: Scenario Analyses

- Recalculate potentials under alternate program scenarios.

3.3 Scenario Analysis

Scenario analysis is a tool commonly used to structure the uncertainty and to examine the robustness of projected outcomes to changes in key underlying assumptions. This section describes the alternative scenarios under which DSM potential was estimated in this study. We developed these DSM potential scenarios for two key reasons:

1. Our estimates of potential depend on future adoptions of energy efficiency measures that are a function of data inputs and assumptions, which are themselves forecasts. For example, our projections depend on estimates of measure availability, measure cost, measure savings, measure saturation levels, retail rates, and avoided costs. Each of the inputs to our analysis is subject to some degree of uncertainty.
2. The ultimate achievable energy efficiency potential depends, by definition, on policy choices, including the level of resources and strategies used to increase measure adoption.

The cost components of program funding that vary under each scenario include:

Marketing and Education Expenditures

- Customers must be aware of efficiency measures and their associated benefits in order to adopt those measures. In our analysis, program marketing expenditures were converted to increases in awareness. Thus, under higher levels of marketing expenditures, higher levels of awareness are achieved.

Incentives and Direct Implementation Expenditures

- The higher the percentage of measure costs paid by the program, the higher the participants' benefit-cost ratios and consequently the number of measure adoptions.

Administration Expenditures

- Purely administrative costs, though necessary and important to the program process, do not directly lead to adoptions; however, they have been included in program funding because they are an input to the program's benefit-cost tests.

For each analysis, four program funding scenarios were considered: a BAU funding scenario without inflation adjustments to the budget, a BAU scenario with administrative and marketing budgets increased annually at the rate of inflation, a 75-percent incentive scenario, and a 100-percent incentive scenario. These scenarios are discussed below.

In all scenarios, ENERGY STAR office equipment and consumer electronics for the residential sector were modeled without financial incentives. Because these measures are very cost-effective, it was deemed that provision of an incentive would primarily benefit free riders.

3.3.1 Business-as-Usual Flat Budget Incentive Scenario

In this scenario, we modeled Austin Energy's existing program budgets and incentive levels. This scenario was used to calibrate the DSM ASSYST model to equate current incentive and other program effort expenditures to expected program savings. Incentives (as a percentage of incremental measure costs) varied by measure under this scenario. For this scenario, marketing and administrative budgets were held constant over the analysis period with no adjustment for inflation.

3.3.2 Business-as-Usual Incentive Scenario

This scenario is identical to the BAU Flat-Budget scenario, except that marketing and administrative budgets were increased at the rate of inflation over the analysis period.

3.3.3 Seventy-five-percent Incentive Scenario

In this scenario, incentives were increased to cover 75 percent of incremental measure costs, except for measures that had constrained incentives as discussed earlier. Program marketing and administration budgets were kept at the same level as the BAU (with inflation adjustment) scenario.

3.3.4 One-hundred-percent Incentive Scenario

In this scenario, incentives were increased to cover 100 percent of incremental measure costs, with the exception of constrained measures. Program marketing and administration budgets were kept at the BAU (with inflation adjustment) level.

3.3.5 Summary of Scenarios

Table 3-1 shows the average spending on electricity programs for each of the scenarios during the 2012–2020 forecast period.

Table 3-1
Scenario Average Spending during 2012–2020 Forecast Period ($1000s)

Funding Level	Market Segment	Cost Components: Admin	Marketing	Incentives	Total	% Incremental Measure Cost Paid
BAU Incentives Flat Budget	Residential Existing	$1,075	$1,120	$8,004	$10,199	24%
	Residential New Construction	$2	$147	$163	$312	26%
	Commercial Existing	$504	$496	$5,385	$6,385	27%
	Commercial New Construction	$331	$301	$0	$632	0%
	Industrial Existing	$130	$124	$1,776	$2,029	32%
	Industrial New Construction	$32	$33	$0	$66	0%
	Total	$2,074	$2,221	$15,328	$19,623	
BAU Incentives	Residential Existing	$1,077	$1,234	$8,024	$10,335	24%
	Residential New Construction	$2	$162	$164	$327	26%
	Commercial Existing	$521	$546	$5,580	$6,647	27%
	Commercial New Construction	$331	$331	$0	$662	0%
	Industrial Existing	$133	$137	$1,826	$2,095	32%
	Industrial New Construction	$34	$37	$0	$70	0%
	Total	$2,097	$2,446	$15,593	$20,136	
75% Incentives	Residential Existing	$2,565	$1,295	$19,800	$23,660	75%
	Residential New Construction	$1	$170	$1,048	$1,219	75%
	Commercial Existing	$1,381	$574	$16,908	$18,863	75%
	Commercial New Construction	$348	$348	$8,696	$9,391	75%
	Industrial Existing	$239	$143	$3,917	$4,299	75%
	Industrial New Construction	$37	$39	$1,374	$1,449	75%
	Total	$4,570	$2,569	$51,743	$58,881	
100% Incentives	Residential Existing	$6,581	$1,357	$40,005	$47,943	100%
	Residential New Construction	$2	$178	$3,213	$3,393	100%
	Commercial Existing	$2,492	$601	$26,740	$29,833	100%
	Commercial New Construction	$364	$364	$20,610	$21,338	100%
	Industrial Existing	$388	$150	$6,263	$6,802	100%
	Industrial New Construction	$40	$40	$3,383	$3,463	100%
	Total	$9,867	$2,691	$100,214	$112,772	

4. Baseline Results

Assessing how energy is used in the Austin Energy service territory by sector, building type, and end use underlies the potential analysis. Characterizing energy use in this way anchors the savings estimates for specific measures to concrete, evidence-based estimates of energy usage by the relevant end use. For example, savings for high-efficiency room air conditioners in single-family homes would be calculated using the baseline estimate of energy used by room air conditioners in single-family homes.

The baseline analysis represents current energy use in Austin Energy's service territory. It addresses all of Austin Energy's energy use with detailed breakouts by building type and end use for the residential, commercial, and industrial sectors. Other sectors, such as agriculture, construction, and utilities, are not included in this potential study and are discussed only at an aggregate level in the baseline analysis. This section presents the results of the baseline analysis.

4.1 Residential Baseline

4.1.1 Residential Billing Analysis

DNV KEMA analyzed residential billing data for fiscal year (FY) 2011 provided by Austin Energy to obtain data by building type (as shown in Table 4-1). The billing data included a large number of accounts (57,927) that lacked a building type description, but accounted for 1.3 percent of total residential energy use. This energy use was split between single family and multifamily in proportion to the accounts with building type information. Based on discussions with Austin Energy, accounts with less than six months of billing data were excluded from the analysis.

For this study, low income was defined by customers' participation in low-income programs, which may not align closely with other definitions of low income.

Table 4-1
Residential Billing Data

	kWh	# of Accts	Avg kWh/acct
Single Family	3,009,253,646	210,250	14,313
Multifamily	1,046,638,733	141,946	7,373
Low Income	147,817,363	12,371	11,949
Total	4,203,709,742	364,567	11,531

4.1.2 Residential Saturations

DNV KEMA's primary source for residential end-use saturations were Austin Energy's *ESource Residential End-Use Study* and a database of audit results collected for compliance with Austin Energy's ECAD. ESource's study provided data about appliance ownership for Travis County (99 homes) for most of the end uses included in the baseline analysis. The ECAD's data (5,893 records) provided detailed information about floor space, insulation levels, HVAC efficiency and condition, and other building characteristics. These data were used primarily for measure saturations (see Appendix E).

In many cases, ESource's data were available by type of home, allowing us to differentiate between single-family and multifamily saturations, or by household income, which allowed us to differentiate low income (DNV KEMA used data for household incomes of less than $25,000 to populate low-income saturations). For consumer electronics and home office equipment, ESource did not break out data by home type but did break it out by home ownership; in these cases, DNV KEMA used rent/lease as a proxy for multifamily.[2]

DNV KEMA used the U.S. Department of Energy's *Residential Energy Consumption Survey* (RECS) to estimate values for the remaining end uses not included in either data set (dishwashers, cooking, and dehumidifiers). DNV KEMA used data for the South Census Region to approximate Austin Energy's saturations for these end uses.

Table 4-2 shows end-use saturations for the residential sector.

For incandescent fixtures, saturation is set to 100 percent for all usage bins for consistency with DNV KEMA's data on equipment density (number of units per home), which we have as only average number of units over all homes, not average number of units per home with incandescent lighting in that usage bin. The available data were not enough to determine saturation, since the average number of lamps is the same with 100 percent saturation and 0.3 lamps per home as with 30 percent saturation and one lamp per home. DNV KEMA used 100 percent saturation here as a modeling choice that is consistent with the way we estimated the energy-use intensity. End-use energy intensities for these measures, presented later in the report, reflect the lower equipment density.

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[2] Austin Energy reviewers noted that Austin has a high saturation of renters of single-family homes; consequently, using this proxy may not accurately reflect electronics equipment saturation in multifamily homes. However, we feel it represents the best available approximation, given the data available.

For early replacement measures, we divided the saturation for the primary equipment type into those that were modeled as ROB and those that were modeled as early replacements (retrofit). For example, we used two water heating base measures, base 40 gallon water heating (EF=0.88) and base early replacement water heating to heat pump water heater. The total electric water heating saturation is 48 percent. We assigned 5 percent to the early replacement measure based on an assessment of the reasonable maximum saturation of heat pump water heaters and assigned the remaining 43 percent to standard ROB measures. We modeled early replacement central- and room-air conditioning similarly, using an 85/15 split to divide the saturation into ROB and early replacement.

The various types of televisions (CRT, LCD, plasma) are modeled as separate types of appliances. Since homes may have multiple types of TVs (for example, a home could have two CRTs and an LCD), the saturations cannot be summed over different types to estimate the total saturation of televisions in homes.

This study addresses only electric equipment; the balance of water heating and cooking equipment uses natural gas or other fuels.

Table 4-2
Residential End-use Saturations

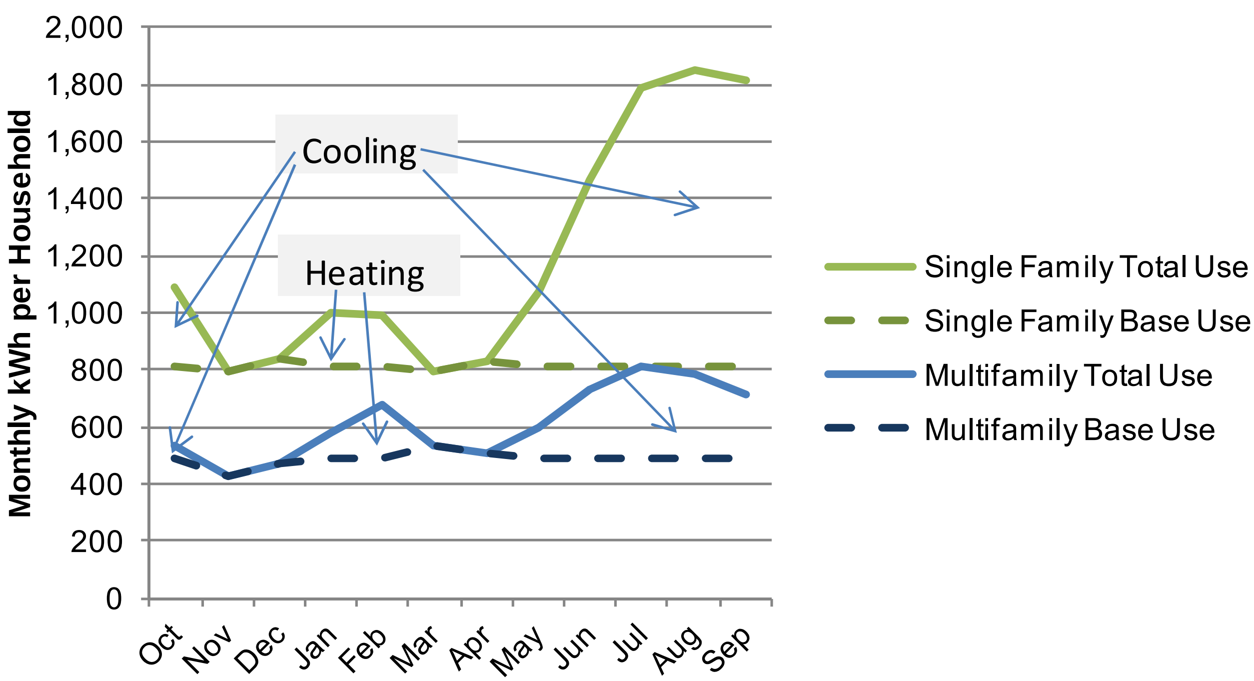
	SF	MF	Low Income	Source
Base Split-System Air Conditioner (11 SEER)	81.6%	79.9%	80.8%	ESource; assumes 85% to ROB
Base Early Replacement Split-System Air Conditioner (11 SEER)	14.4%	14.1%	14.3%	ESource; assumes 15% early replacement
Base Room Air Conditioner - EER 9.7	2.6%	5.1%	1.7%	ESource; assumes 85% to ROB
Base Early Replacement Room Air Conditioner- EER 9.0	0.5%	0.9%	0.3%	ESource; assumes 15% early replacement
Base Dehumidifier- New Federal Standard	8.6%	2.9%	3.4%	RECS 2009
Base Resistance Space Heating (Primary)	6.0%	9.0%	5.0%	ESource
Base Air-Source Heat Pump	14.0%	0.0%	7.0%	ESource
Base High-Efficiency Incandescent Lighting,<1.15 hrs/day	100.0%	100.0%	100.0%	
Base High-Efficiency Incandescent Lighting, 1.15-2.15 hrs/day	100.0%	100.0%	100.0%	
Base High-Efficiency Incandescent Lighting, 2.15-5 hrs/day	100.0%	100.0%	100.0%	
Base High-Efficiency Incandescent Lighting,>5 hrs/day	100.0%	100.0%	100.0%	
Base Lighting 15-Watt CFL, <1.15 hrs/day	84.0%	85.0%	74.0%	ESource
Base Lighting 15-Watt CFL, 1.15-2.15 hrs/day	84.0%	85.0%	74.0%	ESource
Base Lighting 15-Watt CFL, 2.15-5 hrs/day	84.0%	85.0%	74.0%	ESource
Base Lighting 15-Watt CFL, >5 hrs/day	84.0%	85.0%	74.0%	ESource
Base Fluorescent Fixture 1.8 hrs/day	100.0%	100.0%	100.0%	
Base Refrigerator	81.6%	81.6%	79.9%	ESource; assumes 85% to ROB
Base Early Replacement Refrigerator	14.4%	14.4%	14.1%	ESource; assumes 15% early replacement
Base Second Refrigerator	18.0%	9.0%	18.0%	ESource
Base Freezer	21.3%	4.0%	4.3%	ESource; assumes 85% to ROB
Base Early Replacement Freezer	3.8%	2.3%	0.8%	ESource; assumes 15% early replacement
Base 40 gal. Water Heating (EF=0.88)	43.2%	43.2%	43.2%	ESource; assumes 90% to ROB
Base Early Replacement Water Heating to Heat Pump Water Heater	4.8%	4.8%	4.8%	ESource; assumes 10% early replacement
Base Clothes Washer (MEF=1.26)	86.0%	76.0%	76.0%	ESource
Base Clothes Dryer (EF=3.01)	66.0%	66.0%	77.0%	ESource

	SF	MF	Low Income	Source
Base Dishwasher (EF=0.65)	67.0%	57.0%	32.1%	RECS 2009
Base Single Speed Pool Pump (RET)	2.5%	2.5%	0.0%	ESource (total pools, split between single speed and 2 speed)
Base Two Speed Pool Pump (1.5 hp) (ROB)	2.5%	2.5%	0.0%	ESource (total pools, split between single speed and 2 speed)
Base Plasma TV	19.0%	23.0%	31.0%	ESource
Base LCD TV	48.0%	46.0%	24.0%	ESource
Base CRT TV	72.0%	69.0%	81.0%	ESource
Base Set-Top Box	63.0%	63.0%	62.0%	ESource
Base DVD Player	62.0%	57.0%	33.0%	ESource
Base Desktop PC	76.0%	64.0%	60.0%	ESource
Base Laptop PC	73.0%	78.0%	58.0%	ESource
Base Cooking	73.5%	80.9%	72.0%	RECS 2009
Base Miscellaneous	100.0%	100.0%	100.0%	
Base House Practices	100.0%	100.0%	100.0%	

4.1.3 Residential End-use Energy Intensity

DNV KEMA used monthly billing data to separate cooling and heating energy from base loads. Austin Energy's usage was lowest in November–December and March–April. DNV KEMA attributed usage in these months to loads other than heating and cooling. DNV KEMA attributed usage in January–February in excess of this base load to heating and attributed usage above these base levels from May through October to cooling. Through this disaggregation, DNV KEMA calculated heating and cooling use per household for single family, multifamily, and low income (not shown, but similar to single family). This approach is illustrated in Figure 4-1.

Figure 4-1
Analysis of Residential Monthly Energy-use Data



Because 2011 was an unusually hot year, DNV KEMA used heating degree day (HDD) and cooling degree day data to adjust the resulting energy-use values to historic weather norms. Heating and cooling energy were adjusted by calculating energy use per degree day for the billing year and then applied that to the historic average degree day.

Table 4-3: Seasonal Heating and Cooling Degree Day Data, Billing Year and Historical

	Seasonal HDD (Nov-Mar)	Seasonal CDD (May-Sept)
FY2010	2045	2616
FY2011	1587	2818
Historical Average 1971–2000	1568	2472

HDD and CDD (base 65) are from Camp Mabry/Austin City weather station

DNV KEMA pulled additional energy-use data from a variety of sources including the RECS and the U.S. Environmental Protection Agency's ENERGY STAR program savings calculators to determine preliminary estimates of end-use energy intensities (kWh per household for homes with that type of equipment). We then calibrated these values using the results of the earlier-mentioned billing analysis so that cooling, heating, and other end uses accounted for the correct share of residential energy.

Residential end-use energy intensities are shown in Table 4-4.

Table 4-4
Residential End-use Energy Intensities (kWh per Household with the End Use)

	Single Family	Multi-family	Low Income
Base Split-System Air Conditioner (11 SEER)	3,623	1,101	2,822
Base Early Replacement Split-System Air Conditioner (11 SEER)	4,528	1,377	3,528
Base Room Air Conditioner - EER 9.7	1,696	516	1,321
Base Early Replacement Room Air Conditioner- EER 9.0	1,815	552	1,414
Base Dehumidifier- New Federal Standard	1,064	351	851
Base Resistance Space Heating (Primary)	2,784	3,117	5,029
Base Air-Source Heat Pump	1,307	720	1,161
Base High-Efficiency Incandescent Lighting,<1.15 hrs/day	150	98	80
Base High-Efficiency Incandescent Lighting, 1.15-2.15 hrs/day	648	421	345
Base High-Efficiency Incandescent Lighting, 2.15-5 hrs/day	281	182	150
Base High-Efficiency Incandescent Lighting,>5 hrs/day	425	276	226
Base Lighting 15-Watt CFL, <1.15 hrs/day	7	4	4
Base Lighting 15-Watt CFL, 1.15-2.15 hrs/day	58	33	36
Base Lighting 15-Watt CFL, 2.15-5 hrs/day	50	29	31
Base Lighting 15-Watt CFL, >5 hrs/day	76	43	47
Base Fluorescent Fixture 1.8 hrs/day	273	93	105
Base Refrigerator	871	1,003	895
Base Early Replacement Refrigerator	871	1,003	895
Base Second Refrigerator	1,248	1,104	1,036
Base Freezer	666	767	685
Base Early Replacement Freezer	666	767	685
Base 40 gal. Water Heating (EF=0.88)	3,492	2,438	3,587
Base Early Replacement Water Heating to Heat Pump Water Heater	3,492	2,438	3,587
Base Clothes Washer (MEF=1.26)	98	113	101
Base Clothes Dryer (EF=3.01)	1,175	813	967
Base Dishwasher (EF=0.65)	196	226	202
Base Single Speed Pool Pump (RET)	997	1147	1024
Base Two Speed Pool Pump (1.5 hp) (ROB)	617	816	651
Base Plasma TV	285	328	334
Base LCD TV	192	198	206
Base CRT TV	225	172	259
Base Set-Top Box	284	275	290
Base DVD Player	40	37	42
Base Desktop PC	885	798	853
Base Laptop PC	233	235	212
Base Cooking	383	441	394

	Single Family	Multi-family	Low Income
Base Miscellaneous	2,187	48	2,243
Whole House	13,796	7,215	11,552

4.1.4 Residential Building Stock and Energy Use

DNV KEMA used the number of residential accounts as the measure of residential housing stock (see Table 4-5).

Table 4-5
Residential Housing Stock (Accounts) by Building Type

	Single Family	Multifamily	Low Income	Total
Number of Accounts	210,250	141,946	12,371	364,567

DNV KEMA then calculated energy use as the product of number of accounts, saturation, and end-use energy intensity.

Table 4-6 shows energy use by building type and end use; Figure 4-2 summarizes energy use by end use. Space cooling uses the most energy, followed by lighting and water heating. Miscellaneous is the fourth largest category, encompassing all the equipment types for which we did not model efficiency measures. These include household equipment such as audio equipment, telephones, chargers for phones and other portable equipment, hair dryers, power tools, electric lawnmowers, electric vehicles, aquariums, pumps, remote-controlled equipment, decorative light strings, toasters, and coffee machines. Homes also often incorporate infrastructure with small but continuous loads, such as arc fault circuit interrupters and doorbell transformers. Figure 4-3 shows residential energy use by building type.

Table 4-6
Residential Energy Use by Building Type and End Use (MWh)

	Single Family	Multifamily	Low Income	Total
Base Split-System Air Conditioner (11 SEER)	621,541	124,894	28,191	774,625
Base Early Replacement Split-System Air Conditioner (11 SEER)	137,105	27,550	6,219	170,873
Base Room Air Conditioner - EER 9.7	9,095	3,733	278	13,106
Base Early Replacement Room Air Conditioner- EER 9.0	1,717	705	52	2,475
Base Dehumidifier- New Federal Standard	19,148	1,424	356	20,928
Base Resistance Space Heating (Primary)	35,125	39,818	3,111	78,054
Base Air-Source Heat Pump	38,459	-	1,006	39,464

	Single Family	Multifamily	Low Income	Total
Base High-Efficiency Incandescent Lighting,<1.15 hrs/day	31,583	13,852	989	46,424
Base High-Efficiency Incandescent Lighting, 1.15-2.15 hrs/day	136,241	59,753	4,268	200,262
Base High-Efficiency Incandescent Lighting, 2.15-5 hrs/day	59,050	25,898	1,850	86,798
Base High-Efficiency Incandescent Lighting,>5 hrs/day	89,319	39,174	2,798	131,291
Base Lighting 15-Watt CFL, <1.15 hrs/day	1,256	489	41	1,785
Base Lighting 15-Watt CFL, 1.15-2.15 hrs/day	10,187	3,968	329	14,485
Base Lighting 15-Watt CFL, 2.15-5 hrs/day	8,861	3,452	286	12,598
Base Lighting 15-Watt CFL, >5 hrs/day	13,403	5,221	433	19,057
Base Fluorescent Fixture 1.8 hrs/day	57,314	13,135	1,296	71,745
Base Refrigerator	149,516	116,126	8,851	274,493
Base Early Replacement Refrigerator	26,385	20,493	1,562	48,440
Base Second Refrigerator	47,226	14,108	2,306	63,640
Base Freezer	29,773	4,353	360	34,485
Base Early Replacement Freezer	5,254	2,448	64	7,766
Base 40 gal. Water Heating (EF=0.88)	317,128	149,470	19,173	485,771
Base Early Replacement Water Heating to Heat Pump Water Heater	35,236	16,608	2,130	53,975
Base Clothes Washer (MEF=1.26)	17,699	12,148	946	30,792
Base Clothes Dryer (EF=3.01)	163,094	76,147	9,212	248,453
Base Dishwasher (EF=0.65)	27,680	18,290	801	46,770
Base Single Speed Pool Pump (RET)	5,240	4,070	-	9,309
Base Two Speed Pool Pump (1.5 hp) (ROB)	3,241	2,896	-	6,137
Base Plasma TV	11,381	10,700	1,279	23,360
Base LCD TV	19,341	12,938	611	32,889
Base CRT TV	34,108	16,807	2,599	53,514
Base Set-Top Box	37,577	24,595	2,223	64,395
Base DVD Player	5,227	2,982	172	8,381
Base Desktop PC	141,394	72,487	6,333	220,214
Base Laptop PC	35,731	26,026	1,522	63,279
Base Cooking	59,255	50,635	3,510	113,400
Base Miscellaneous	459,777	6,806	27,747	494,331
Total	**2,900,663**	**1,024,198**	**142,905**	**4,067,766**

Figure 4-2
Residential Energy Use by End Use

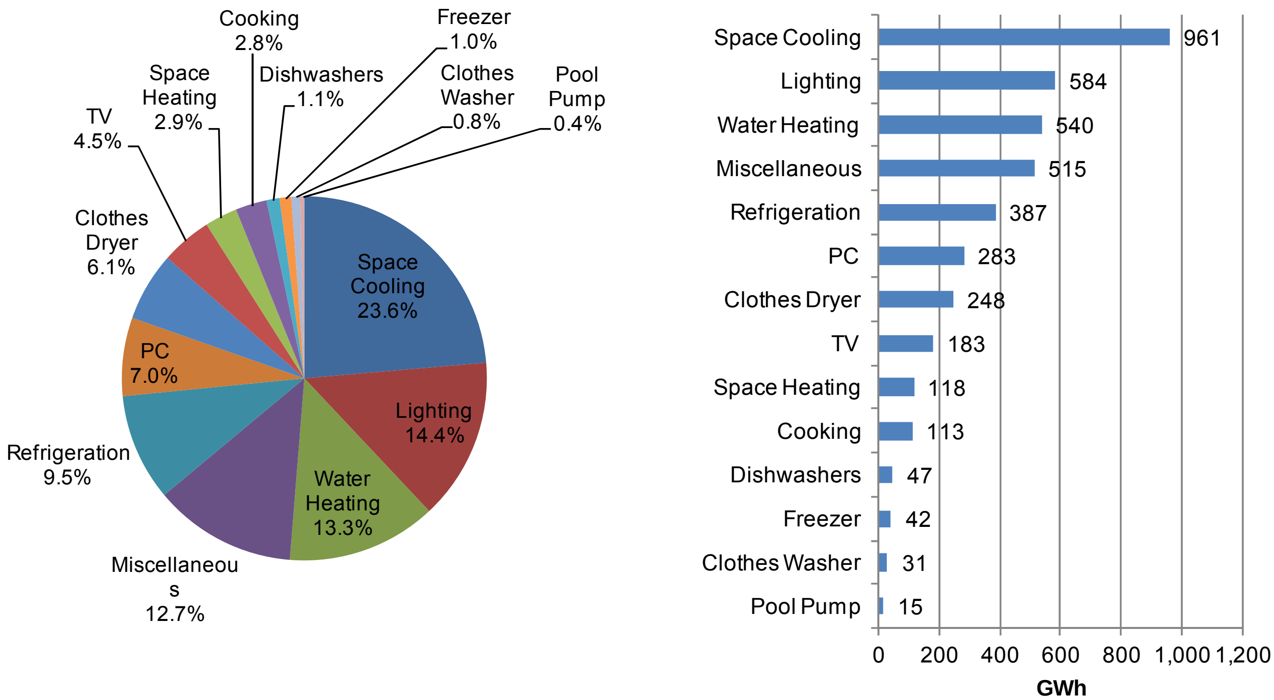
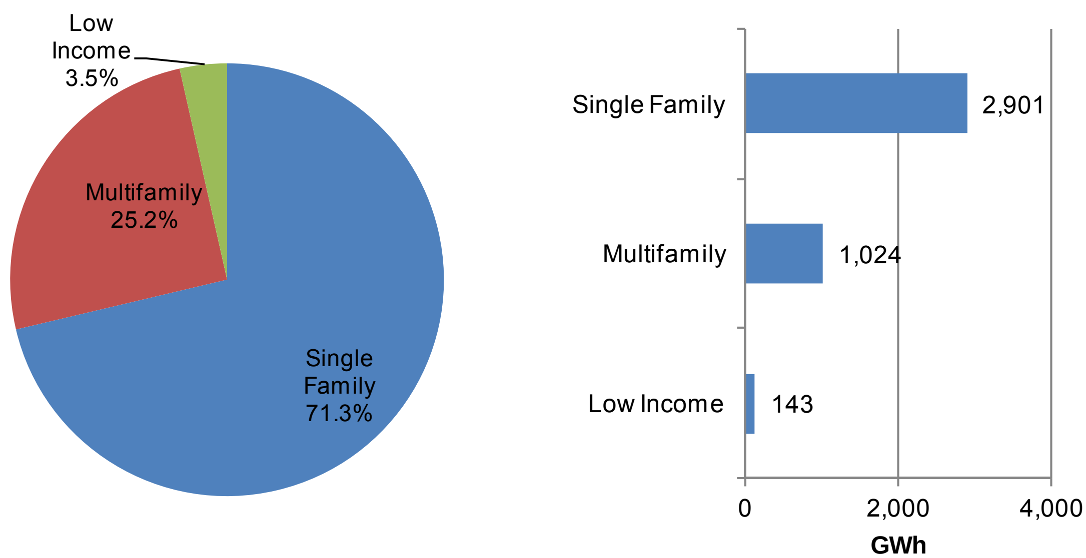


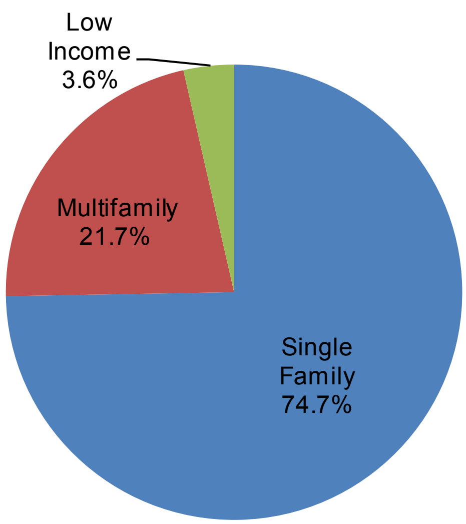
Figure 4-3
Residential Energy Use by Building Type

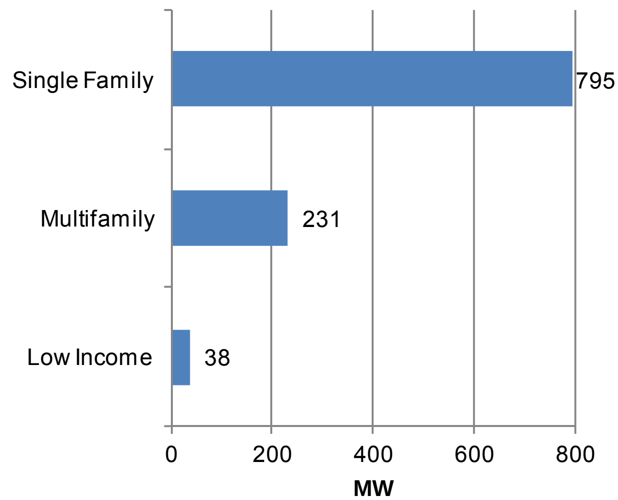


4.1.5 Residential Peak Demand

DNV KEMA calibrated residential peak demand basing it on coincident peak data from Austin Energy's December 2011 rate proposal, which presented Test Year 2009 demand by customer class.[3] Figure 4-4 and Figure 4-5 summarize commercial peak demand by building type and end use, respectively.

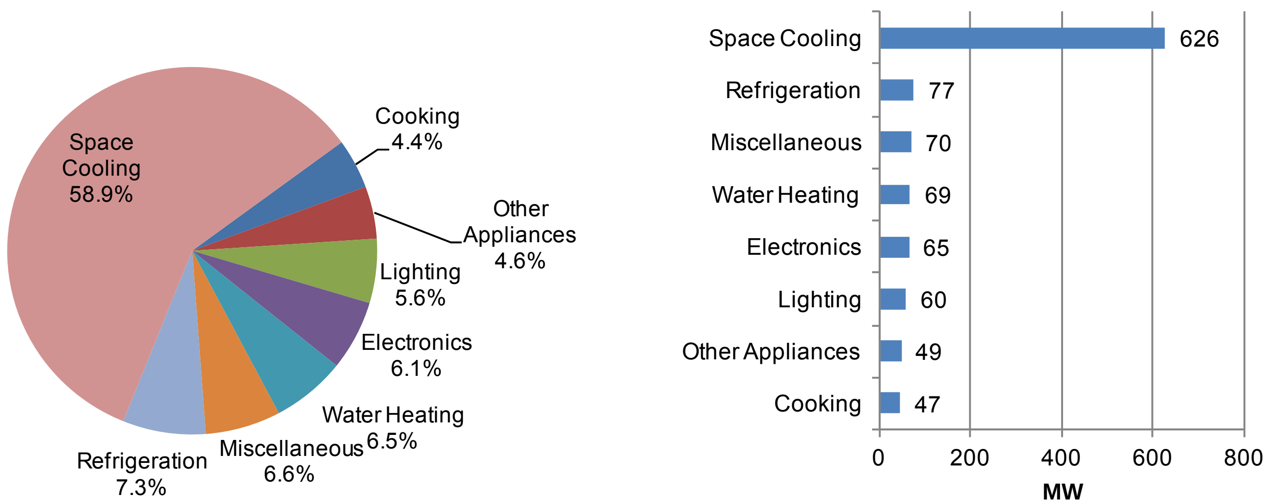
Figure 4-4
Residential Peak Demand by Building Type





[3] Austin Energy, 2011. *Rate Analysis and Recommendations Report*. Provided to the Austin City Council, December 19, 2011, Table 2.3.

Figure 4-5
Residential Peak Demand by End Use



4.2 Non-residential Baseline

4.2.1 Non-residential Building Type Analysis

Austin Energy provided non-residential billing data in four bins: city of Austin, contract accounts, key accounts, and other non-residential accounts. The city of Austin's data were for the period from October 2009 to September 2010; all others were from October 2010 to September 2011. DNV KEMA split the city of Austin's data into water/wastewater (based on the departmental information provided in the billing database) and all other, since water/wastewater is analyzed with industrial energy use in DSM ASSYST. The remainder of the city of Austin's energy use was analyzed as commercial energy use. Table 4-7 summarizes the billing data.

Table 4-7
Summary of Austin Energy's Non-residential Billing Data

	Accounts	Annual kWh	September 2011 kW
Commercial Accounts	34,371	2,998,818,532	832,391
Key Accounts	5,813	2,163,890,707	493,822
Contract Accounts	77	2,084,844,809	354,758
City of Austin, excluding Water/Wastewater	621	165,110,455	55,527
Water/Wastewater (City of Austin)	189	179,781,732	37,106
Total	41,071	7,592,446,235	1,773,604

Because the industry classification data in Austin Energy's billing data were incomplete, Christopher Frye of Austin Energy selected a database sample to be matched with NAICS codes to inform the energy use breakout by building type and sector (commercial and industrial). That sample included 7,422 accounts. Table 4-8 and Figure 4-7 show the resulting building type breakouts for the commercial sector. Table 4-9 and Figure 4-11 show the corresponding data for the industrial sector. The industrial sector is dominated by the electronics industry, which includes manufacturers of computers and consumer electronics as well as non-high-tech electric appliances and housewares.

Table 4-8
Commercial Energy Use and Billed kW by Building Type

	Annual kWh	Percentage of kWh	September 2011 kW	Percentage of kW
Office	1,818,557,330	40%	444,374	40%
Restaurant	335,912,042	7%	86,245	8%
Retail	614,638,532	14%	157,068	14%
Grocery	198,504,635	4%	38,095	3%
Warehouse	88,498,033	2%	30,642	3%
School	238,344,088	5%	92,837	8%
College	394,140,682	9%	70,377	6%
Health	197,287,774	4%	38,081	3%
Lodging	121,023,640	3%	30,822	3%
City of Austin	165,110,455	4%	55,527	5%
Other	367,776,127	8%	112,532	10%
Total	4,539,793,338		1,101,073	

Note: City of Austin excludes water/wastewater (it is analyzed with the industrial sector). "Other" commercial buildings include, but are not limited to: movie theaters, video rental businesses, gas stations, recording studios, data processing and hosting, news syndicates, libraries and archives, internet publishing, car rental and leasing, other rental and leasing, architectural and engineering services, laboratories, photography studios, veterinary services, trade schools, performing arts, sports facilities, museums, historical sites, amusement parks, arcades, casinos, golf courses, marinas, fitness centers, bowling alleys, auto repair, car washes, other repair shops, barber shops and beauty salons, funeral homes, drycleaners and laundromats, parking garages, religious organizations, courts, and correctional institutions.

Table 4-9
Industrial Energy Use by Industry

	Annual kWh	Percentage of kWh	September 2011 kW	Percentage of kW
Food	13,843,841	1%	3,799	1%
Textiles	4,244,421	0%	1,858	0%
Wood	2,174,334	0%	1,129	0%
Paper	941,897	0%	271	0%
Printing	54,130,937	3%	14,171	4%
Chemicals	42,610,985	2%	9,288	2%
Petroleum	1,491,313	0%	283	0%
Plastics	1,405,171	0%	568	0%
Stone, Clay, Glass	6,553,990	0%	4,646	1%
Fab. Metals	2,541,689	0%	1,137	0%
Ind. Mach	86,211,086	4%	13,937	4%
Electronics	1,596,381,411	79%	283,608	74%
Transp. Equip.	24,071,404	1%	6,364	2%
Misc.	16,156,402	1%	6,179	2%
WWTP (COA)	179,781,732	9%	37,106	10%
Total	2,032,540,614		384,344	

Note: WWTP includes only city of Austin (COA) water and wastewater facilities as identified in the city of Austin's billing database. It does not include water/ wastewater treatment by other industrial customers.

4.3 Commercial Baseline

4.3.1 Commercial Saturations

There was no local survey or audit data for the commercial sector comparable to what was available for the residential sector. Instead, DNV KEMA relied primarily on the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) to develop equipment saturations by building type. In order to have a sufficient number of data points for reliability, DNV KEMA used data for the East South Central and West South Central census divisions. For some non-weather-sensitive measures, DNV KEMA relied on its extensive database of saturation data from other potential studies. Saturations by building type and end use are shown in Table 4-10.

DNV KEMA relied on the expertise of Austin Energy's staff members to assess the data taken from these sources based on their experiences with local customers. DNV KEMA made a number of adjustments to lighting, space cooling (especially the mix of chillers and DX systems), and space heating.

There are nine lighting base measures. Due to recent changes to federal lighting standards, we did not analyze T12s as a separate base measure. T12s are rolled in with T8 base measures, and the effect of their higher energy use is accounted for in our energy intensity estimates. The effect of the standards on savings is captured through a standards adjustment factor.

We have three primary base measures that cover the majority of general service office lighting: 2-lamp 4-foot T8 fixtures, 4-lamp 4-foot T8 fixtures, and other fluorescent fixtures, which include U-tubes and 8-foot lamps, among others. Together, these illuminate 88 percent of office floor space.

Table 4-10
Commercial End-use Saturations by Building Type (% of Square Feet with End Use)

End Use	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Lodging	City of Austin	Other
Base Fluorescent Fixture, 4L 4'T8	50%	4%	19%	86%	40%	80%	34%	65%	7%	43%	37%
Base Fluorescent Fixture, 2L 4'T8, 1 EB	32%	40%	6%	0%	0%	7%	51%	17%	40%	33%	35%
Base Other Fluorescent Fixture	6%	15%	6%	0%	0%	3%	6%	6%	2%	4%	2%
Base High-Efficiency Incandescent Flood, 53W to Screw-in Replacement	3%	17%	4%	3%	4%	2%	2%	3%	21%	5%	6%
Base High-Efficiency Incandescent Flood, 53W to Hardwired Replacement	3%	17%	4%	3%	4%	2%	2%	3%	21%	5%	6%
Base CFL	7%	10%	2%	2%	4%	2%	5%	11%	18%	6%	5%
Base High Bay Metal Halide, 400W	2%	1%	1%	17%	24%	3%	2%	2%	1%	4%	6%
Base Parking Garage Metal Halide, 250 W	0%	0%	0%	0%	0%	0%	18%	7%	0%	0%	0%
Base Parking Garage Fluorescent	10%	0%	0%	0%	0%	0%	0%	0%	2%	8%	7%
Base Exit Sign	82%	79%	42%	99%	100%	100%	100%	100%	100%	90%	98%
Base Outdoor High Pressure Sodium 250W Lamp	42%	100%	45%	99%	43%	93%	52%	93%	74%	64%	87%
Base Centrifugal Chiller, 0.58 kW/ton, 500 tons	42%	1%	4%	0%	0%	25%	74%	82%	30%	27%	12%
Base DX Packaged System, EER=10.3, 10 tons	43%	77%	28%	69%	78%	52%	0%	18%	25%	51%	60%
Base PTAC, EER=8.3, 1 ton	1%	8%	1%	12%	4%	11%	0%	3%	50%	4%	8%
Base Fan Motor, 5hp, 1800rpm, 87.5%	42%	50%	43%	97%	30%	33%	82%	19%	65%	48%	54%
Base Fan Motor, 15hp, 1800rpm, 91.0%	40%	0%	2%	0%	0%	60%	69%	65%	0%	41%	43%
Base Fan Motor, 40hp, 1800rpm, 93.0%	5%	0%	2%	96%	10%	37%	69%	69%	11%	19%	34%
Base Built-up Refrigeration System	0%	38%	0%	11%	3%	8%	1%	1%	2%	0%	0%
Base Self-contained Refrigeration	2%	40%	5%	100%	0%	57%	0%	5%	41%	2%	1%
Base Desktop PC	100%	75%	33%	88%	81%	95%	100%	100%	90%	88%	75%
Base Monitor, CRT	24%	27%	29%	2%	92%	75%	36%	67%	27%	31%	38%
Base Monitor, LCD	100%	95%	62%	97%	100%	93%	99%	92%	100%	100%	100%
Base Copier	94%	14%	20%	43%	72%	82%	100%	100%	51%	78%	61%
Base Laser Printer	100%	100%	98%	100%	99%	100%	100%	100%	97%	100%	99%

Table 4-10
Commercial End-use Saturations by Building Type (% of Square Feet with End Use)

End Use	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Lodging	City of Austin	Other
Base Data Center/Server Room	0.3%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.2%	0.0%	0%	0%
Base Water Heating	51%	30%	34%	5%	50%	30%	3%	0%	0%	42%	32%
Base Vending Machines	100%	24%	100%	100%	73%	83%	37%	88%	18%	85%	69%
Base Cooking	2%	67%	7%	97%	0%	90%	30%	22%	33%	4%	6%
Base Heating	55%	7%	30%	0%	0%	0%	0%	0%	33%	28%	1%
Base Miscellaneous	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

4.3.2 Commercial End-Use Energy Intensity

DNV KEMA developed commercial end-use energy intensity (kWh per end-use square foot) from a variety of sources, including California's *Commercial End-Use Survey*, a study which included on-site measurements of energy use. DNV KEMA has found that the CBECS energy intensities (kWh per total square feet) and end-use energy intensities provide a useful starting place for non-weather sensitive end uses. DNV KEMA then calibrated the values to agree with Austin Energy's overall consumption.

Commercial end-use energy intensities are shown in Table 4-11 by building type and end use.

Table 4-11
Commercial End-use Energy Intensity (kWh per Applicable Square Foot)

	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Lodging	City of Austin	Other
Base Fluorescent Fixture, 4L 4'T8	8.0	6.8	3.7	7.5	1.6	3.2	8.5	5.6	1.8	5.3	2.6
Base Fluorescent Fixture, 2L 4'T8, 1 EB	4.6	3.0	2.2	6.2	1.4	2.2	5.3	2.7	1.3	3.3	2.1
Base Other Fluorescent Fixture	3.6	0.0	1.0	0.0	2.1	0.4	2.2	2.1	0.6	2.1	0.5
Base High-Efficiency Incandescent Flood, 53W to Screw-in Replacement	24.3	3.0	3.9	5.1	0.0	0.2	4.3	2.7	3.6	13.7	3.1
Base High-Efficiency Incandescent Flood, 53W to Hardwired Replacement	24.3	3.0	3.9	5.1	2.8	0.2	4.3	2.7	3.6	13.7	3.1
Base CFL	1.4	0.8	0.6	6.3	0.7	1.3	1.3	0.9	0.6	1.0	0.6
Base High Bay Metal Halide, 400W	0.0	0.1	0.0	11.0	1.2	3.3	13.5	0.0	2.0	0.5	1.1
Base Parking Garage Metal Halide, 250 W	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0
Base Parking Garage fluorescent	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.7
Base Exit Sign	0	0	0	0	0	0	0	0	0	0	0
Base Outdoor Metal Halide 295W Lamp	1.0	3.6	1.2	0.4	0.6	0.8	0.7	0.4	0.4	0.7	0.4
Base Centrifugal Chiller, 0.58 kW/ton, 500 tons	2.6	5.2	1.9	3.2	1.0	1.2	2.3	3.8	1.8	1.84	1.1
Base DX Packaged System, EER=10.3, 10 tons	4.5	9.1	3.3	5.3	1.7	2.0	4.1	6.7	3.1	3.20	1.9
Base PTAC, EER=8.3, 1 ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	3.3	1.60	3.2
Base Fan Motor, 5hp, 1800rpm, 87.5%	2.8	4.5	2.5	4.1	1.2	1.1	2.5	4.6	2.1	2.1	1.4
Base Fan Motor, 15hp, 1800rpm, 91.0%	2.6	4.2	2.4	3.8	1.1	1.0	2.3	4.2	1.9	1.9	1.3
Base Fan Motor, 40hp, 1800rpm, 93.0%	2.6	4.1	2.3	3.7	1.1	1.0	2.2	4.1	1.9	1.9	1.2
Base Built-up Refrigeration System	0.48	4.9	1.2	22.4	2.3	0.5	0.5	0.5	0.9	0.69	0.9
Base Self-contained Refrigeration	0.48	4.9	1.1	20.0	2.3	0.5	0.5	0.6	0.9	0.69	0.9
Base Desktop PC	1.2	0.3	0.1	0.1	0.2	0.2	0.1	0.7	0.0	0.6	0.1
Base Monitor, CRT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Base Monitor, LCD	0.4	0.1	0.0	0.0	0.1	0.1	0.0	0.2	0.0	0.2	0.0
Base Copier	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Base Laser Printer	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Base Data Center/Server Room	236.0	265.8	282.2	407.5	25.9	94.6	75.2	118.3	194.9	176.1	116.2

Table 4-11
Commercial End-use Energy Intensity (kWh per Applicable Square Foot)

	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Lodging	City of Austin	Other
Base Water Heating	0.3	2.2	0.3	0.5	0.1	0.2	0.2	0.4	1.0	0.3	0.4
Base Vending Machines	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Base Cooking	0.1	10.4	0.3	2.2	0.0	0.2	0.3	0.4	0.7	0.2	0.3
Base Heating	0.6	0.3	0.4	0.6	0.4	0.2	1.0	1.0	0.5	0.5	0.4
Base Miscellaneous	0.8	1.4	0.8	1.0	0.4	0.3	0.5	2.5	1.1	0.9	1.1

Note: Data center EUIs are per square foot of data center or server room. The saturations for data centers consider that only a small percentage of floor space for each building type is devoted to data storage activities.

4.3.3 Commercial Building Stock and Energy Use

DNV KEMA estimated commercial floor space by building type based on saturations, end-use energy intensity, and total energy use by building type. Essentially, floor space was used as a calibration factor to ensure that the modeled energy use balanced with DNV KEMA's energy-use estimates by building type; the resulting floor space is presented in Table 4-12. Commercial energy use by building type and end use is presented in Table 4-13. Figure 4-6 summarizes commercial energy use by end use, and Figure 4-7 does the same for commercial energy use by building type.

Table 4-12
Commercial Building Stock by Building Type (Thousand Square Feet)

	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Lodging	City of Austin	Other	Total
Floor space (1000 sf)	103,918	11,237	113,598	4,236	21,521	31,157	27,149	9,670	12,650	13,371	50,440	398,947

Table 4-13
Commercial Energy Use by Building Type and End Use (MWh)

	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Lodging	City of Austin	Other	Total
Base Fluorescent Fixture, 4L 4'T8	415,228	3,377	79,943	27,311	13,373	80,241	77,569	35,591	1,611	30,859	48,996	814,099
Base Fluorescent Fixture, 2L 4'T8, 1 EB	152,823	13,607	15,931	95	123	5,023	72,454	4,352	6,622	14,898	36,491	322,418
Base Other Fluorescent Fixture	23,732	0	7,041	0	17	399	3,575	1,151	126	1,122	466	37,630
Base High-Efficiency Incandescent Flood, 53W to Screw-in Replacement	81,128	5,820	19,197	706	0	111	2,701	831	9,643	8,711	9,981	138,830
Base High-Efficiency Incandescent Flood, 53W to Hardwired Replacement	81,128	5,820	19,197	706	2,379	111	2,701	831	9,643	8,711	9,981	141,210
Base CFL	10,554	870	1,325	516	670	945	1,762	881	1,449	822	1,501	21,294
Base High Bay Metal Halide, 400W	0	6	0	7,798	6,372	3,005	7,189	0	188	280	3,049	27,887
Base Parking Garage Metal Halide, 250 W	0	0	0	0	0	0	543	284	0	0	0	828
Base Parking Garage Fluorescent	1,678	0	0	0	0	0	0	0	95	457	2,165	4,394
Base Exit Sign	1,277	517	698	46	83	328	613	262	315	109	153	4,401
Base Outdoor High Pressure Sodium 250W Lamp	45,202	40,479	61,355	1,815	5,137	22,787	10,329	3,397	3,421	6,151	17,142	217,215
Base Centrifugal Chiller, 0.58 kW/ton, 500 tons	113,986	472	9,336	0	0	8,913	47,102	30,620	6,797	6,610	6,299	230,134
Base DX Packaged System, EER=10.3, 10 tons	200,525	78,946	105,229	15,469	27,905	32,164	80	11,437	9,817	21,853	56,257	559,681
Base PTAC, EER=8.3, 1 ton	0	0	0	0	0	0	0	570	20,842	953	12,885	35,250
Base Fan Motor, 5hp, 1800rpm, 87.5%	124,233	25,755	124,926	16,891	7,655	11,358	54,638	8,310	17,160	13,407	36,784	441,118
Base Fan Motor, 15hp, 1800rpm, 91.0%	108,315	0	4,031	0	0	18,881	42,655	26,744	0	10,689	27,151	238,467
Base Fan Motor, 40hp, 1800rpm, 93.0%	12,313	0	3,950	15,155	2,304	11,500	41,802	27,849	2,692	4,881	21,114	143,560

Table 4-13
Commercial Energy Use by Building Type and End Use (MWh)

	Office	Restaurant	Retail	Grocery	Warehouse	School	College	Health	Lodging	City of Austin	Other	Total
Base Built-up Refrigeration System	56	21,240	636	10,127	1,495	1,222	120	53	250	8	29	35,236
Base Self-contained Refrigeration	1,121	22,279	6,378	84,454	0	8,042	0	314	4,761	148	437	127,935
Base Desktop PC	120,320	2,195	2,681	197	3,313	7,102	2,228	6,637	477	7,239	2,966	155,356
Base Monitor, CRT	241	62	116	1	253	55	104	245	16	20	0	1,112
Base Monitor, LCD	46,752	911	2,252	63	1,212	1,833	607	1,799	144	3,148	1,072	59,792
Base Copier	3,862	73	446	29	315	127	119	568	24	241	215	6,017
Base Laser Printer	16,997	249	3,005	34	577	408	244	773	101	1,169	600	24,155
Base Data Center/Server Room	82,060	515	5,778	1,170	125	244	1,482	2,434	555	3,945	31	98,339
Base Water Heating	16,327	7,484	9,656	108	726	1,963	195	0	0	1,826	5,649	43,934
Base Vending Machines	5,947	383	11,638	697	1,441	3,288	1,181	493	265	556	1,432	27,320
Base Cooking	273	78,905	2,189	8,877	0	5,039	2,632	918	3,013	109	841	102,796
Base Heating	33,527	272	12,269	0	29	0	59	0	2,015	1,816	105	50,091
Base Miscellaneous	79,061	15,619	90,878	4,320	9,424	8,101	13,575	24,563	14,168	12,306	54,475	326,491
Total	1,778,664	325,857	600,080	196,587	84,927	233,189	388,259	191,907	116,209	163,042	358,266	4,436,988

Figure 4-6
Commercial Energy Use by End Use

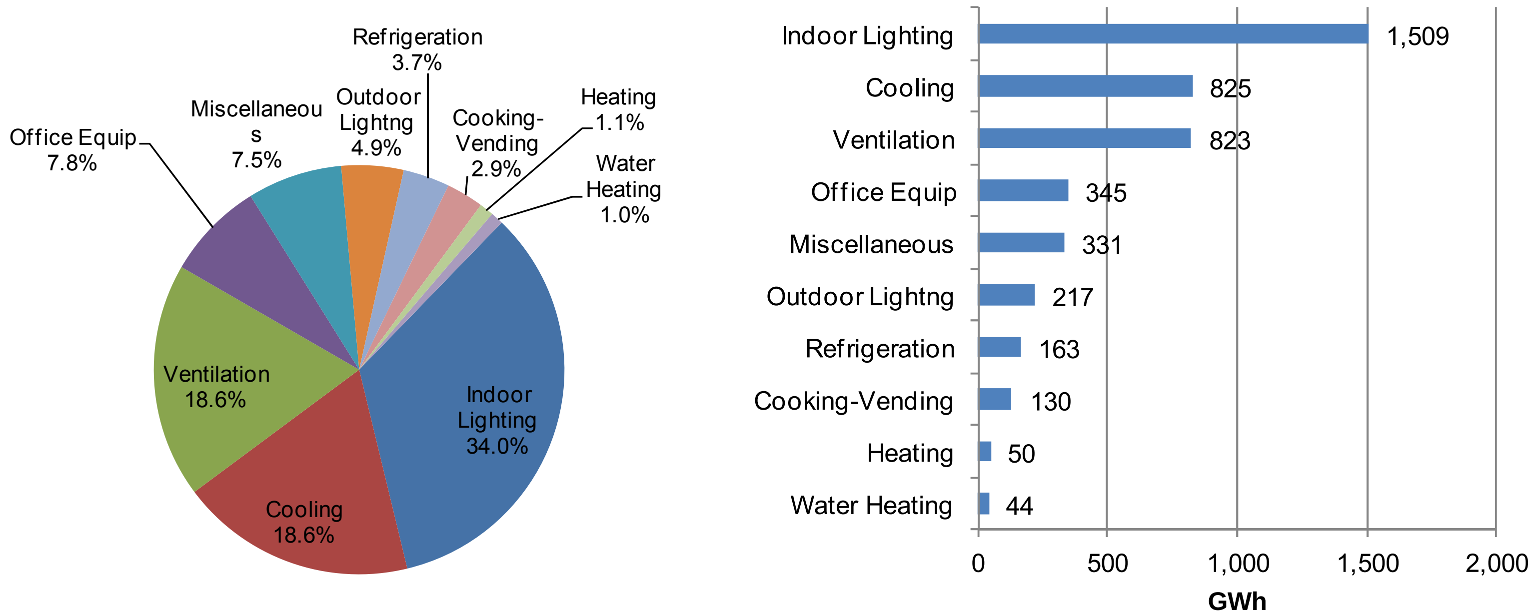
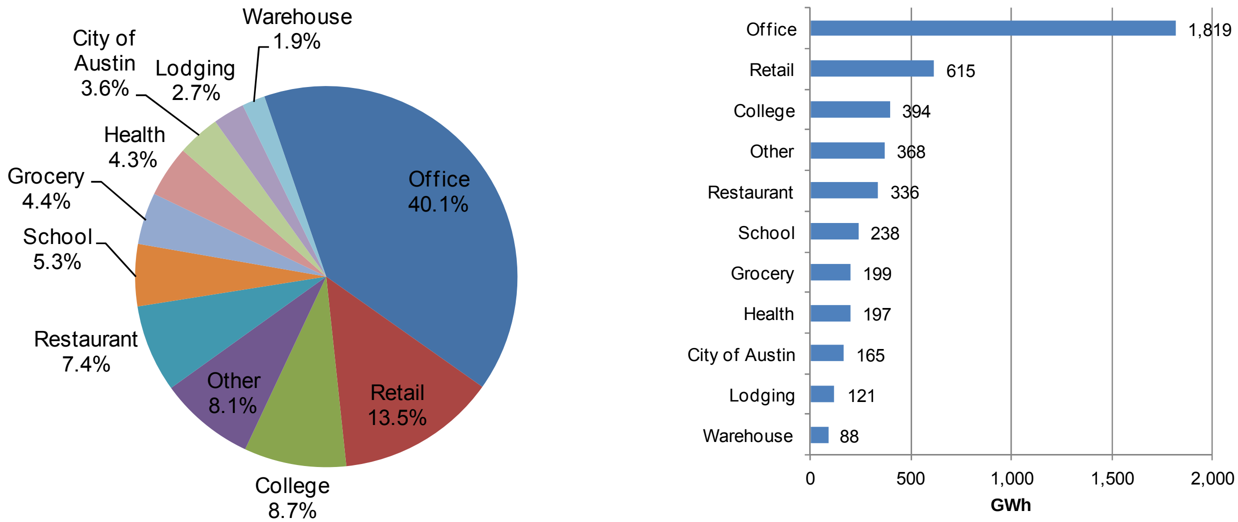


Figure 4-7
Commercial Energy Use by Building Type



4.3.4 Commercial Peak Demand

Table 4-14 shows commercial peak demand by building type and end use. DNV KEMA calibrated sector peak demand basing it on coincident peak data from Austin Energy's December 2011 rate proposal, which presented Test Year 2009 demand by customer class.[4] DNV KEMA summed the non-residential classes, then distributed these into commercial, industrial, and other (agriculture, construction, etc.) in proportion to non-coincident peak data from the billing database. A comparison of the coincident and non-coincident peak data presented in the rate proposal suggests that the share of peak by customer class is similar for the two types of peak. Figure 4-8 and Figure 4-9 summarize commercial peak demand by building type and end use, respectively.

[4] Austin Energy, 2011. *Rate Analysis and Recommendations Report*. Provided to the Austin City Council, December 19, 2011, Table 2.3.

Table 4-14
Commercial Peak Demand (MW) by Building Type and End Use

	Office	Restau-rant	Retail	Grocery	Ware-house	School	College	Health	Lodging	City of Austin	Other	Total
Base Fluorescent Fixture, 4L 4'T8	63.4	0.6	12.8	4.1	2.0	6.5	15.5	5.1	0.3	4.6	7.0	122.0
Base Fluorescent Fixture, 2L 4'T8, 1 EB	23.3	2.6	2.6	0.0	0.0	0.4	14.5	0.6	1.0	2.2	5.2	52.5
Base Other Fluorescent Fixture	3.6	0.0	1.1	0.0	0.0	0.0	0.7	0.2	0.0	0.2	0.1	5.9
Base High-Efficiency Incandescent Flood, 53W to Screw-in Replacement	12.4	1.1	3.1	0.1	0.0	0.0	0.5	0.1	1.5	1.3	1.4	21.6
Base High-Efficiency Incandescent Flood, 53W to Hardwired Replacement	12.4	1.1	3.1	0.1	0.4	0.0	0.5	0.1	1.5	1.3	1.4	22.0
Base CFL	1.6	0.2	0.2	0.1	0.1	0.1	0.4	0.1	0.2	0.1	0.2	3.3
Base High Bay Metal Halide, 400W	0.0	0.0	0.0	1.2	0.9	0.2	1.4	0.0	0.0	0.0	0.4	4.3
Base Parking Garage Metal Halide, 175 W	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Base Parking Garage Fluorescent	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.6
Base Exit Sign	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.6
Base Outdoor High Pressure Sodium 250W Lamp	3.0	5.2	10.2	0.1	0.3	2.3	0.3	0.2	0.2	0.6	2.5	24.9
Base Centrifugal Chiller, 0.58 kW/ton, 500 tons	52.7	0.3	6.1	0.0	0.0	2.4	23.1	13.8	3.4	3.5	3.7	109.0
Base DX Packaged System, EER=10.3, 10 tons	92.7	42.2	68.7	8.6	17.7	8.7	0.0	5.2	5.0	11.5	33.2	293.5
Base PTAC, EER=8.3, 1 ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	10.6	0.5	7.6	18.9
Base Fan Motor, 5hp, 1800rpm, 87.5%	26.9	5.9	30.0	3.2	1.8	1.4	13.2	1.5	3.2	3.0	8.3	98.4
Base Fan Motor, 15hp, 1800rpm, 91.0%	23.4	0.0	1.0	0.0	0.0	2.3	10.3	4.7	0.0	2.4	6.2	50.3
Base Fan Motor, 40hp, 1800rpm, 93.0%	2.7	0.0	0.9	2.9	0.5	1.4	10.1	4.9	0.5	1.1	4.8	29.9
Base Built-up Refrigeration System	0.0	2.9	0.1	1.4	0.2	0.2	0.0	0.0	0.0	0.0	0.0	4.9
Base Self-contained Refrigeration	0.1	3.0	0.9	11.9	0.0	1.0	0.0	0.0	0.6	0.0	0.1	17.7
Base Desktop PC	13.6	0.4	0.4	0.0	0.4	0.5	0.4	0.8	0.1	0.8	0.3	17.7
Base Monitor, CRT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Base Monitor, LCD	5.3	0.2	0.3	0.0	0.2	0.1	0.1	0.2	0.0	0.4	0.1	6.9
Base Copier	0.4	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.7
Base Laser Printer	1.9	0.0	0.5	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	2.9
Base Data Center/Server Room	9.2	0.1	0.9	0.2	0.0	0.0	0.2	0.3	0.1	0.5	0.0	11.5
Base Water Heating	1.9	1.2	1.4	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.8	5.7
Base Vending Machines	0.7	0.1	1.9	0.1	0.2	0.2	0.2	0.1	0.0	0.1	0.2	3.7
Base Cooking	0.0	16.0	0.3	1.2	0.0	0.2	0.5	0.2	0.6	0.0	0.1	19.1

	Office	Restau-rant	Retail	Grocery	Ware-house	School	College	Health	Lodging	City of Austin	Other	Total
Base Heating	2.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	2.2
Base Miscellaneous	9.1	3.0	14.6	0.6	1.6	0.4	2.4	2.9	2.3	1.6	7.8	46.4
Total	362.8	86.1	161.3	36.0	26.6	28.5	94.7	41.7	31.5	36.0	92.0	997.4

Figure 4-8
Commercial Peak Demand by Building Type

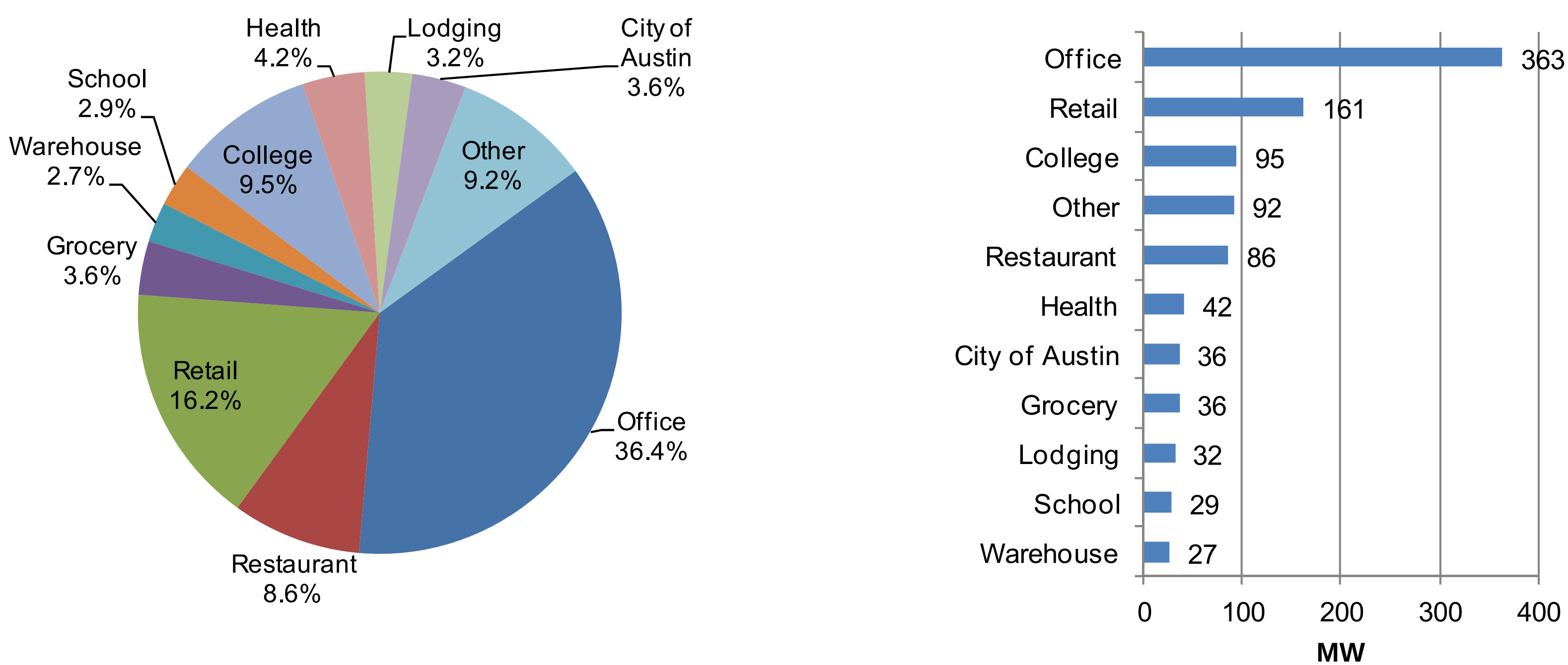
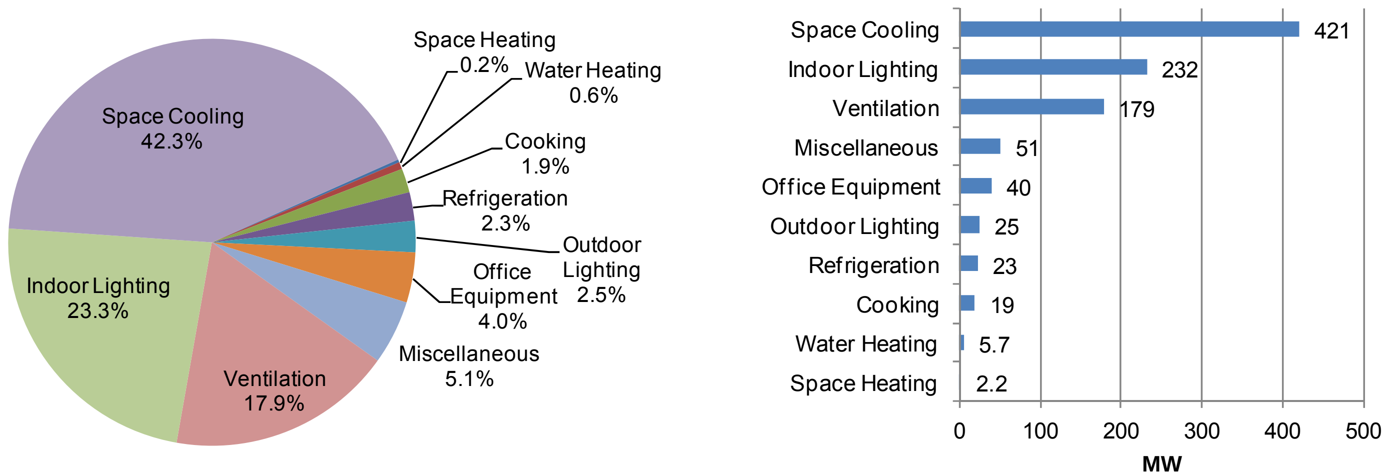


Figure 4-9
Commercial Peak Demand by End Use



4.4 Industrial Baseline

4.4.1 Industrial Saturations

Table 4-15 shows end-use saturations for the industrial sector by industry, representing the percentage of total energy use for each end use. Within each industry, the sum of the end-use saturations equals 100 percent of total industry energy use. These values were derived from the U.S. Department of Energy's *Manufacturing Energy Consumption Survey* (MECS).

Table 4-15
End-Use Saturations by Industry

	Compressed Air	Fans	Pumps	Drives	Process Heating	Refrigeration	Other Process	Chiller	DX	Lighting	Other	Total
Food	7.6%	8.3%	14.7%	14.1%	8.2%	26.0%	1.0%	0.0%	8.5%	7.4%	4.2%	100%
Textiles	3.5%	6.6%	8.9%	30.4%	10.5%	11.6%	1.5%	0.8%	12.8%	10.4%	3.0%	100%
Wood	4.5%	8.6%	11.3%	40.5%	9.3%	1.3%	0.8%	0.0%	6.7%	8.4%	8.6%	100%
Paper	3.6%	14.6%	24.2%	31.8%	11.6%	1.6%	2.1%	0.0%	4.3%	3.9%	2.3%	100%
Printing	3.6%	6.9%	9.0%	32.3%	3.6%	5.9%	0.8%	1.1%	17.6%	12.1%	7.1%	100%
Chemicals	2.5%	6.5%	26.2%	21.0%	9.3%	8.0%	14.4%	0.3%	5.5%	3.7%	2.6%	100%
Petroleum	12.3%	7.4%	49.2%	13.1%	5.0%	5.4%	0.6%	0.0%	3.6%	2.3%	1.1%	100%
Plastics	3.5%	6.6%	8.7%	31.4%	16.0%	9.0%	1.7%	0.6%	10.1%	8.6%	3.8%	100%
Stone, Clay, Glass	5.9%	13.9%	17.7%	20.1%	21.9%	2.7%	3.3%	0.0%	6.3%	5.2%	3.0%	100%
Fab. Metals	11.8%	6.6%	8.7%	21.9%	20.0%	3.5%	4.8%	0.6%	9.4%	9.4%	3.3%	100%
Ind. Mach	14.4%	5.2%	6.8%	18.3%	7.0%	2.8%	2.5%	1.3%	20.9%	14.5%	6.2%	100%
Electronics	10.1%	3.1%	4.0%	8.6%	15.3%	8.7%	7.8%	17.8%	5.9%	11.6%	7.2%	100%
Transp. Equip.	12.3%	5.5%	7.2%	11.8%	14.5%	6.2%	3.4%	1.1%	18.0%	14.6%	5.3%	100%
Misc.	8.9%	3.3%	4.3%	16.2%	10.2%	5.9%	1.5%	0.7%	24.0%	16.7%	8.2%	100%
WWTP (COA)	0.3%	30.0%	62.1%	0.0%	1.3%	0.3%	0.0%	0.3%	2.0%	4.0%	0.0%	100%

4.4.2 Industrial Energy Use

The industrial analysis in DSM ASSYST was based on kWh used (compared to square feet for commercial and households for residential). Therefore, the building stock and the energy use by industry are the same. Table 4-16 shows energy use by building type and end use, based on the billing analysis (building type) and MECS (end use). Figure 4-10 summarizes industrial energy use by end use, and Figure 4-11 shows energy use by industry.

Table 4-16
Industrial Energy Use (MWh) by Industry and End Use

	Compressed Air	Fans	Pumps	Drives	Process Heating	Refrigeration	Other Process	Chiller	DX	Lighting	Other	Total
Food	1,042	1,141	2,007	1,929	1,125	3,553	137	0	1,158	1,010	580	13,682
Textiles	146	276	370	1,266	435	485	62	33	532	435	126	4,165
Wood	98	185	243	873	200	29	17	0	143	182	185	2,154
Paper	34	136	227	298	109	15	19	0	40	37	21	936
Printing	1,911	3,617	4,743	17,060	1,914	3,111	406	575	9,294	6,368	3,752	52,750
Chemicals	1,077	2,733	11,088	8,855	3,925	3,377	6,074	145	2,344	1,550	1,093	42,263
Petroleum	183	110	730	195	75	80	8	0	53	35	17	1,484
Plastics	49	92	121	434	221	124	23	9	140	119	53	1,384
Stone, Clay, Glass	386	906	1,150	1,304	1,422	175	216	0	406	335	197	6,497
Fab. Metals	297	165	217	549	500	88	120	15	237	235	83	2,507
Ind. Mach	12,019	4,352	5,707	15,304	5,841	2,347	2,077	1,083	17,507	12,156	5,217	83,609
Electronics	155,819	47,217	61,916	132,446	235,648	133,651	119,850	275,655	91,885	178,915	111,936	1,544,938
Transp. Equip.	2,879	1,289	1,690	2,776	3,399	1,465	791	261	4,219	3,420	1,253	23,444
Misc.	1,395	518	679	2,532	1,586	926	239	102	3,752	2,610	1,278	15,617
WWTP (COA)	449	53,775	111,417	0	2,244	449	0	518	3,522	7,173	0	179,546
Total	177,782	116,511	202,304	185,820	258,645	149,877	130,040	278,394	135,232	214,579	125,791	1,974,976

Figure 4-10
Industrial Energy Consumption by End Use

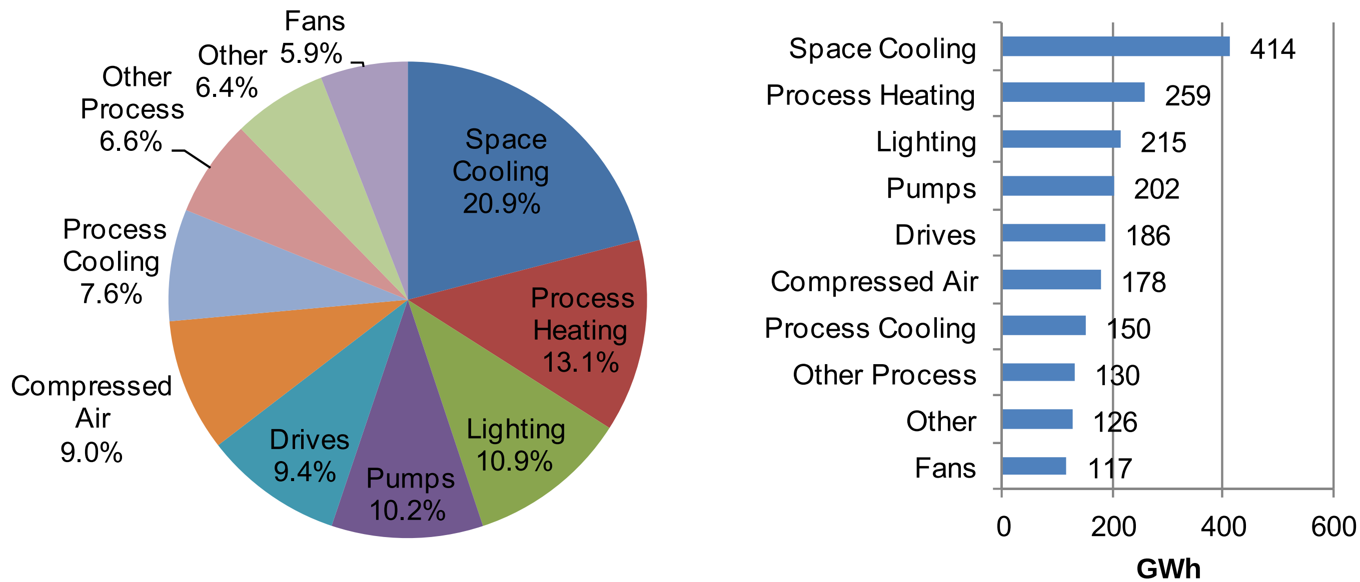
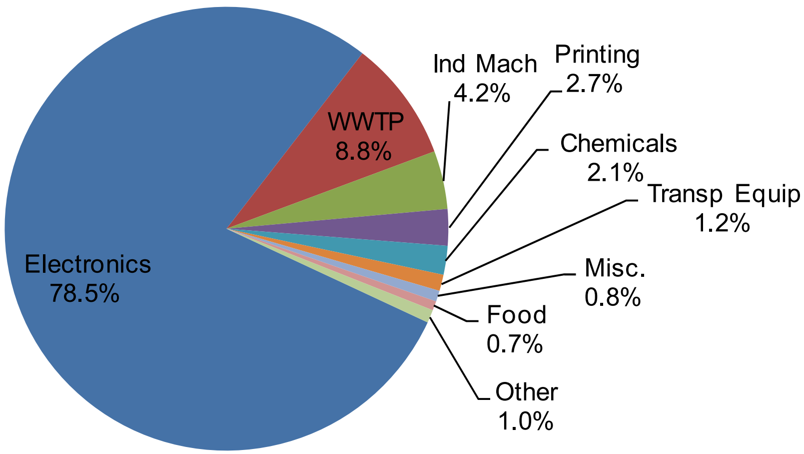
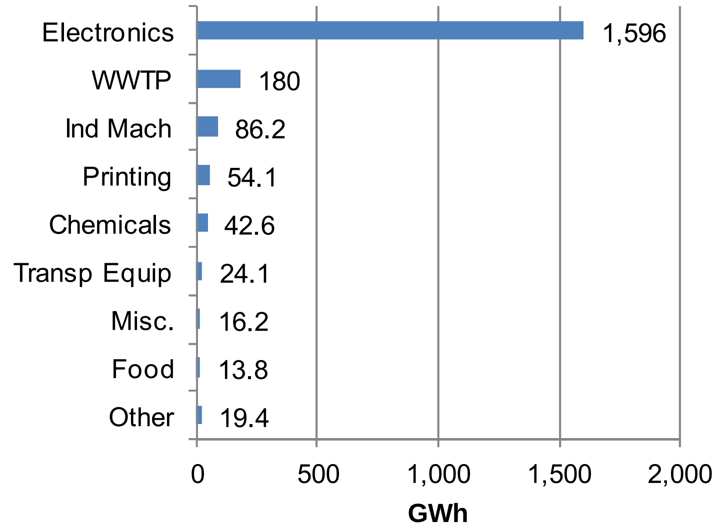


Figure 4-11
Industrial Energy Use by Industry





Note: "Other" includes stone/clay/glass, textiles, fabricated metals, lumber/furniture, petroleum, rubber/plastics, and paper.

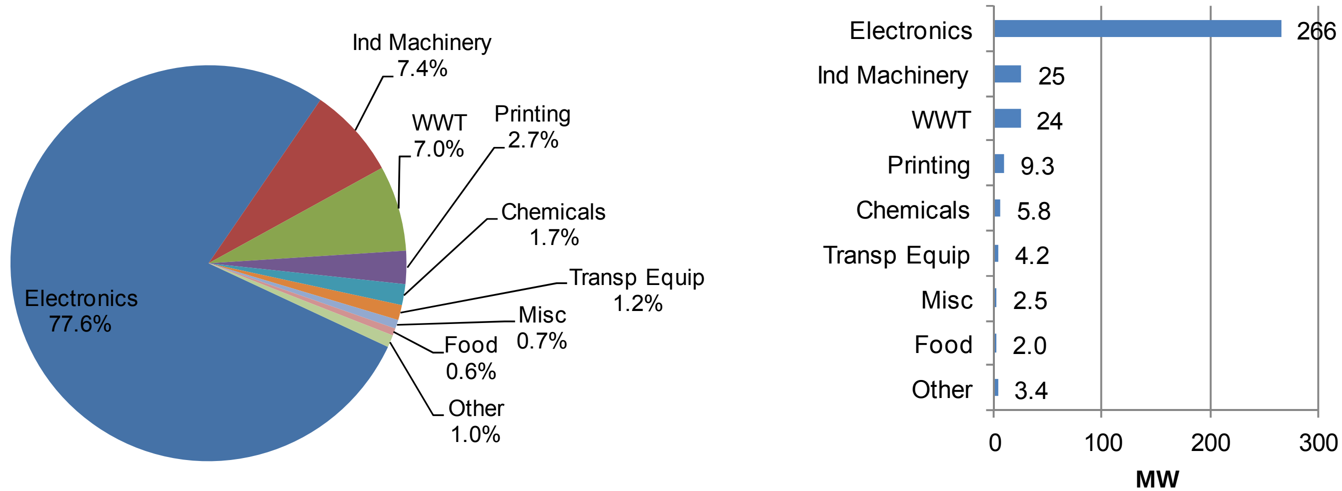
4.4.3 Industrial Peak Demand

Table 4-17 shows industrial peak demand by industry and energy use. Figure 4-12 summarizes peak demand by industry, and Figure 4-13 shows peak demand by industrial end use.

Table 4-17
Industrial Peak Demand (MW) by Industry and End Use

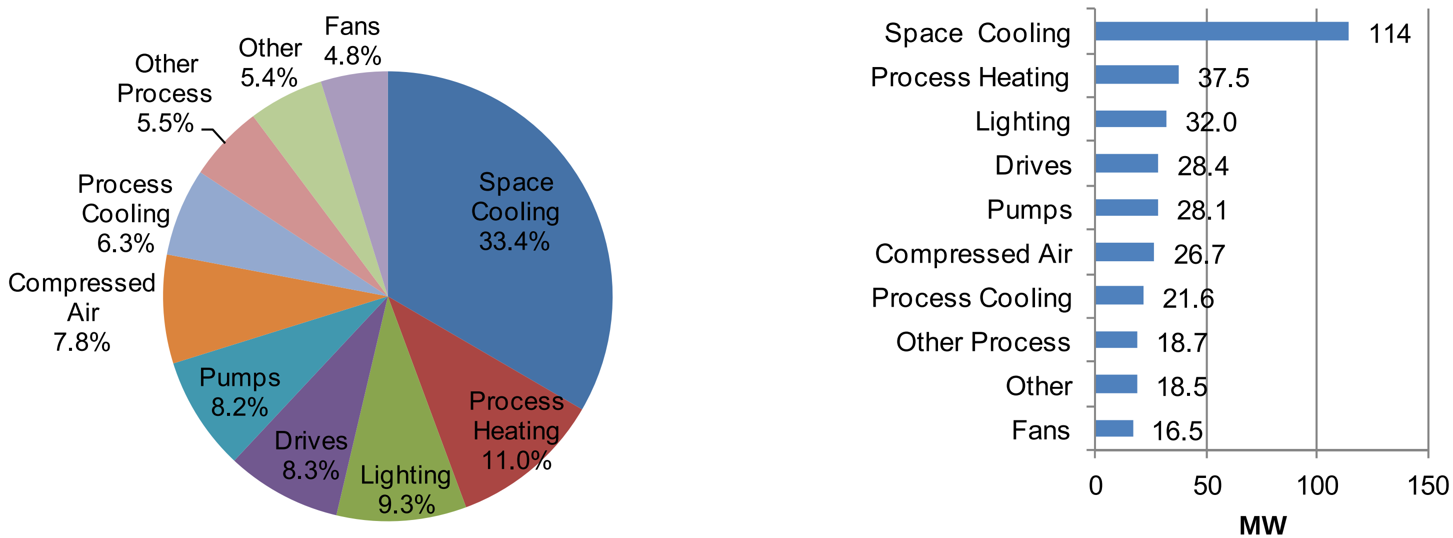
	Compressed Air	Fans	Pumps	Drives	Heating	Refrigeration	Other Process	Chiller	DX	Lighting	Other	Total
Food	0.14	0.16	0.28	0.27	0.16	0.49	0.02	0.00	0.30	0.14	0.08	2.03
Textiles	0.04	0.07	0.09	0.32	0.11	0.12	0.02	0.02	0.25	0.11	0.03	1.19
Lumber	0.02	0.03	0.04	0.15	0.03	0.00	0.00	0.00	0.04	0.03	0.03	0.38
Paper	0.00	0.01	0.02	0.03	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.09
Printing	0.29	0.55	0.72	2.57	0.29	0.47	0.06	0.16	2.62	0.96	0.57	9.26
Chemicals	0.14	0.36	1.46	1.16	0.52	0.44	0.80	0.04	0.58	0.20	0.14	5.84
Petroleum	0.02	0.01	0.10	0.03	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.20
Plastics	0.01	0.01	0.02	0.07	0.04	0.02	0.00	0.00	0.04	0.02	0.01	0.24
Stone, Clay, glass	0.05	0.12	0.15	0.17	0.19	0.02	0.03	0.00	0.10	0.04	0.03	0.89
Fab. Metals	0.05	0.03	0.03	0.09	0.08	0.01	0.02	0.00	0.07	0.04	0.01	0.42
Ind. Machinery	3.07	1.11	1.46	3.90	1.49	0.60	0.53	0.52	8.35	3.10	1.33	25.45
Electronics	22.2	6.7	8.8	18.9	33.6	19.0	17.1	73.5	24.5	25.5	16.0	265.7
Transp. Equip.	0.45	0.20	0.26	0.43	0.53	0.23	0.12	0.08	1.22	0.53	0.19	4.23
Misc.	0.18	0.07	0.09	0.33	0.21	0.12	0.03	0.02	0.92	0.34	0.17	2.48
WWT	0.06	7.02	14.55	0.00	0.29	0.06	0.00	0.13	0.86	0.94	0.00	23.91
Total	26.7	16.5	28.1	28.4	37.5	21.6	18.7	74.4	39.9	32.0	18.5	342.3

Figure 4-12
Industrial Peak Demand by Industry



Note: “Other” includes stone/clay/glass, textiles, fabricated metals, lumber/furniture, petroleum, rubber/plastics, and paper.

Figure 4-13
Industrial Peak Demand by End Use



4.5 Summary of Energy Use and Peak Demand by Sector

Figure 4-14 and Figure 4-15 summarize the breakdown for energy use and peak demand, respectively, by sector. In addition to the residential, commercial, and industrial sectors analyzed in this report, these figures include agriculture, construction, communications, transportation, and utilities (except for water/wastewater, which are included in industrial).

Figure 4-14
Summary of Energy Use by Sector

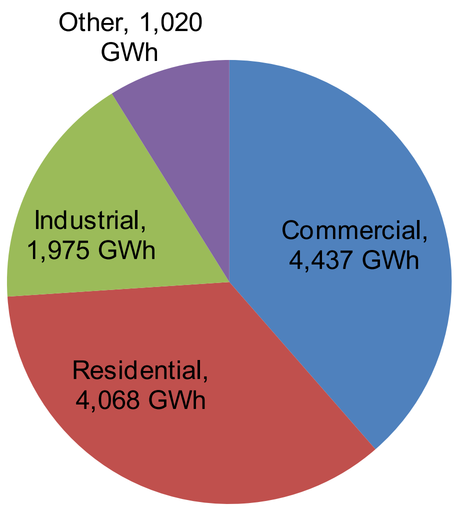
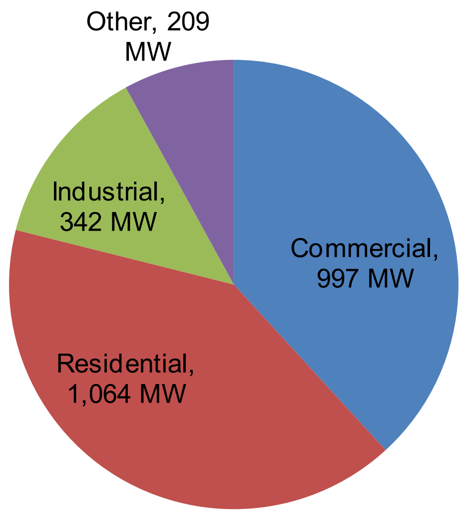


Figure 4-15
Summary of Peak Demand by Sector



4.6 2020 Baseline

Up to this point in this chapter, the analysis represents Austin Energy's 2011 energy use and peak demand, with weather adjustments applied to create an appropriate starting point for the analysis in the next chapter. To correctly identify the opportunities for energy savings, it is important to understand how energy is being used and by whom. However, to present the achievable program potential for 2012–2020, we need to estimate what energy use and peak demand would be in 2020 in the absence of the program. We turned to Austin Energy's forecast of 2020 energy use and peak demand as a basis for calibrating growth and decay rates in the model so that the base (no energy efficiency) forecast would agree with Austin Energy's.

Austin Energy's approaches to managing energy consumption include building codes, load management, Green Building, and energy efficiency programs. The focus of this report is to examine energy efficiency in new and existing buildings, which encompasses the effects of Austin Energy's energy efficiency programs and the non-code-related efforts of its Green Building program. For the purposes of this report, DNV KEMA considered the effects of Austin Energy's building codes and load management efforts to be part of the baseline energy use. Table 4-18 shows how DNV KEMA's baseline for this analysis relates to Austin Energy's no-DSM forecast and its load management and building code savings forecasts.

Table 4-18
DNV KEMA 2020 Baseline versus Austin Energy's 2020 Forecast

	Energy	Demand
	GWh	MW
No Demand Side Management Forecast 2020	14,971	3,963
- Building Codes (cumulative 2011-2020)	-332	-154
- Load Management (cumulative 2011-2020)	-3.6	-82
Baseline for DNV KEMA Analysis	14,635	3,727

Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

In the model, the 2020 forecast relates to the base-year energy use using decay factors that are applied to existing buildings (assumed to be 0.5 percent per year) for non-residential buildings and 1 percent for residential buildings) and an annual new construction building stock adder. The 2020 forecast includes nine years of new construction, but the remaining 2011 building stock is only 91 percent of its original level for residential and 96 percent for commercial.

We set the growth rate in the building stock so that the model's energy-use output agreed with Austin Energy's forecast. The resulting forecast, by sector and by new/existing construction, is shown in Table 4-19. The table shows the surviving stock from the beginning of the analysis period (existing) and new construction between 2012 and 2020.

Table 4-19
2020 Base Energy Use and Demand Forecast

		Energy (GWh)	Demand (MW)
Residential	Existing	3,976	1,169
Commercial	Existing	4,538	1,147
Industrial	Existing	2,020	394
Other	Existing	1,092	250
Subtotal	Existing	11,626	2,959
Residential	New	1,065	313
Commercial	New	1,306	330
Industrial	New	638	124
Other	New	0	0
Subtotal	New	3,009	767
Residential	Total	5,041	1,482
Commercial	Total	5,844	1,477
Industrial	Total	2,658	518
Other	Total	1,092	250
Total		14,635	3,727

Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

In the following chapter, we use the 2011 baseline to present technical and economic potential results. Technical and economic potential are instantaneous potentials, meaning that they estimate the savings that would accrue if everyone implemented the analyzed measures immediately. As a result, the effect of Austin's building code changes over the next several years are not addressed in these calculations. Therefore, the technical and economic potentials include some savings potential that will be captured by codes and will not be available for energy efficiency programs.

For the achievable analysis, which calculates program savings potential over the 2012–2020 period, we switched to the 2020 base for estimating percentage savings. We also re-weighted the technical and economic potential using the same approach described above for base use, so that we can make comparisons between technical, economic, and achievable potentials on the same base (that is, representing nine years of new construction and nine years of decay in existing buildings).

5. Electric Energy Efficiency Potential Results

In this section, we present estimates of electric energy efficiency potential.

Line losses are factored into all potential calculations. In addition, for consistency with Austin Energy's forecasts, an additional factor for spinning reserves is included in the demand results. The line losses (transmission and distribution) factor is 7 percent; the factor for demand, including both line losses and spinning reserves, is 20 percent. The 2011 baseline energy use and peak demand developed in Sections 4.1 through 4.5 were based on billing data and were therefore "at the meter." However, for consistency with Austin Energy's 2020 forecast, DNV KEMA's 2020 baseline (Section 4.6) included these factors. In this chapter, line losses and (for demand) spinning reserves have been added to baselines so that baselines and potential estimates can be compared on the same basis and be compared with Austin Energy's forecasts.

5.1 Technical and Economic Potential

Estimates of overall energy efficiency technical and economic potential are discussed in Section 5.1.1. More detail on these potentials is presented in Section 4. Energy-efficiency supply curves are shown in Section 5.1.3.

5.1.1 Overall Technical and Economic Potential

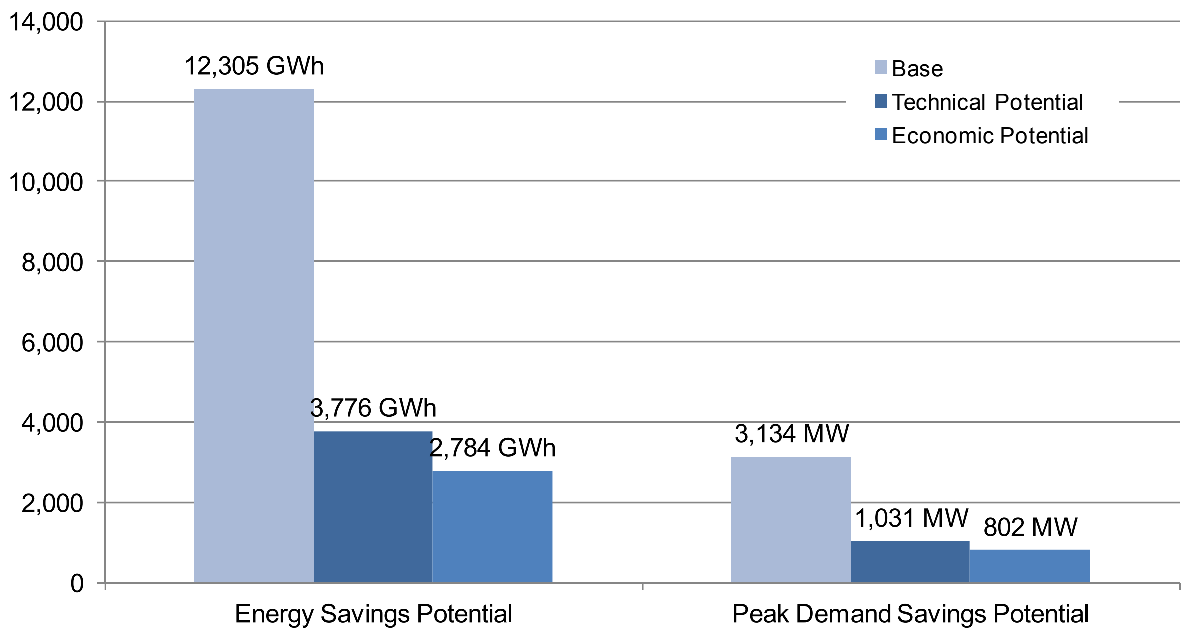
Figure 5-1 presents our overall estimates of total technical and economic potential for electrical energy and peak-demand savings for Austin Energy's service territory. *Technical potential* represents the sum of all savings from all of the measures deemed applicable and technically feasible. *Economic potential* is based on efficiency measures that are cost-effective, which is based on the total resource cost (TRC) test—a benefit-cost test that compares the value of avoided energy production and power-plant construction to the costs of energy efficiency measures and program activities necessary to deliver them. The values of both energy savings and peak-demand reductions are incorporated in the TRC test.

Energy Savings. Technical potential for existing buildings is estimated at about 3,776 GWh per year for existing buildings, and economic potential at 2,784 GWh per year (about 31 percent and 23 percent of base usage, respectively). These are the savings that would accrue if all the measures (cost-effective measures for economic potential) were installed immediately without needing to wait for stock turnover. The savings for one year's worth of new construction are 58

GWh technical potential and 57 GWh economic potential (approximately 15 percent of base usage for both).

Peak-demand Savings. Technical potential for existing buildings is estimated at about 1,031 MW, and economic potential at 802 MW (about 33 percent and 26 percent of base demand, respectively). The potentials for one year's worth of new construction are 12.5 MW technical potential and 12.4 MW economic potential (about 13 percent of base demand for both).

Figure 5-1
Estimated Electric Technical and Economic Potential for Existing Buildings, Austin Energy's Service Territory



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

5.1.2 Technical and Economic Potential Detail

In this subsection, we explore technical and economic potential in more detail, looking at potentials by new versus existing buildings, sector, and end use.

5.1.2.1 Technical and Economic Potential for Existing Buildings

Existing Buildings Potentials by Sector

Figure 5-2 and Figure 5-3 show estimates of technical and economic energy and demand savings potentials by sector. Figure 5-4 and Figure 5-5 show the same potentials as a percentage of base energy and base peak demand.

As discussed in Section 4.2, this analysis separates commercial and industrial sectors from Austin Energy's non-residential customers, based on NAICS codes. Industrial is primarily manufacturing plus water/wastewater treatment.

The economic potential for the commercial and residential sectors are similar for energy, but the residential potential is greater for peak-demand savings. While the industrial sector contributes low amounts to the potentials, many industrial measures are complex, custom measures that are difficult to completely address in a bottom-up study such as this one, and this effect could lead to understating industrial potentials.

Figure 5-2
Technical and Economic Potential for Existing Buildings Energy Savings by Sector—GWh per Year

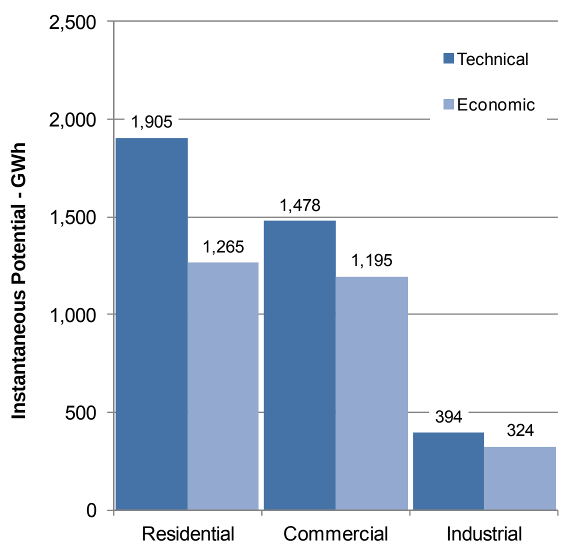
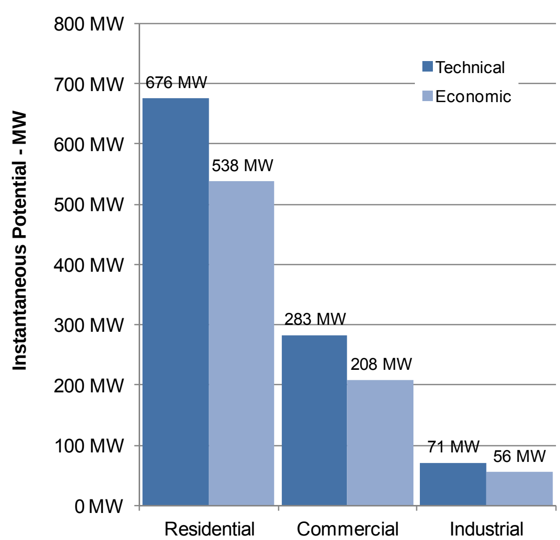


Figure 5-3
Technical and Economic Potential for Existing Buildings Demand Savings by Sector—MW



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

As shown in Figure 5-4 and Figure 5-5, the residential and commercial sectors have similar economic energy savings potential in relation to base use (29 percent and 25 percent, respectively), but the peak-demand potential is much greater for residential (42 percent versus 17 percent). The estimated savings fraction is lowest for the industrial sector, but this potential is in the 14–22 percent of cost-effective industrial savings, as estimated by the National Academy of Sciences.[5]

Figure 5-4
Technical and Economic Potential for Existing Buildings Percentage of Base Energy Use

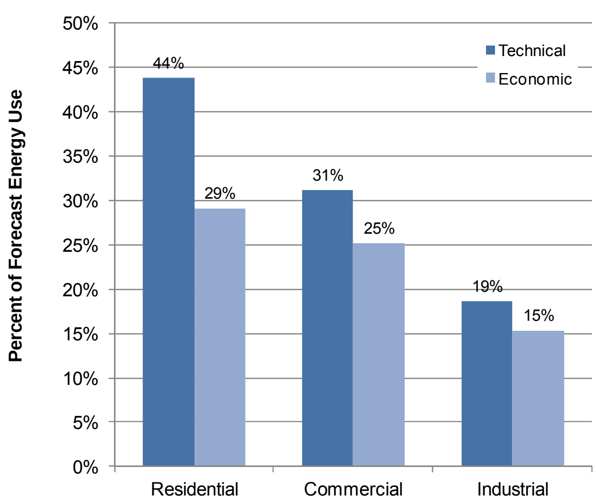
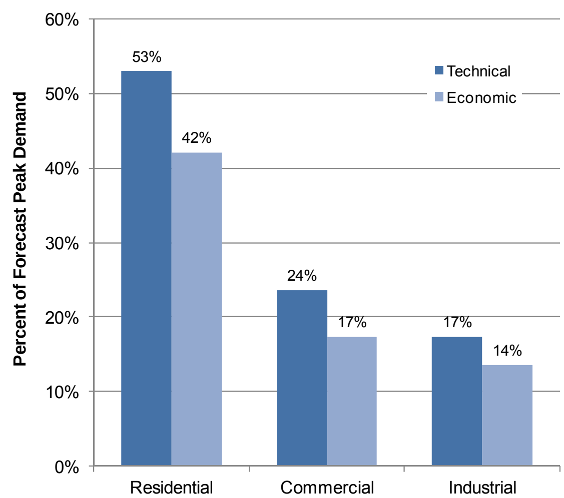


Figure 5-5
Technical and Economic Potential for Existing Buildings Percentage of Base Peak Demand



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

[5] *Real Prospects for Energy Efficiency in the United States*, America's Energy Future Energy Efficiency Subcommittee, National Academy of Sciences, National Academy of Engineering, National Research Council, 2009.

Existing Buildings Potentials by Building Type

Figure 5-6 and Figure 5-7 show residential sector potentials by building type. Single-family homes account for about 77 percent of the economic energy savings potential, and low-income[6] homes account for about 3.6 percent of the potential. Single-family homes account for 85 percent of demand potential.

Figure 5-6
Residential Existing Buildings
Energy-savings Potential by Building Type

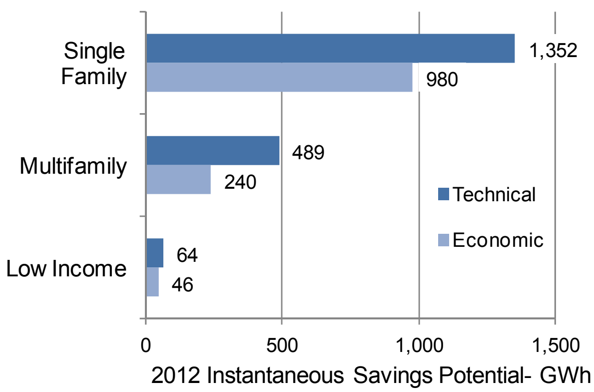
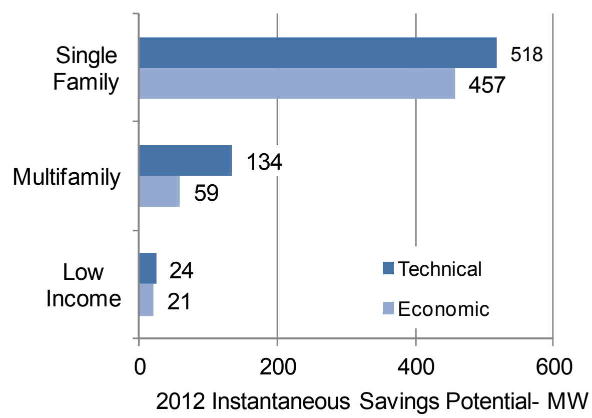


Figure 5-7
Residential Existing Buildings
Demand-savings Potential by Building Type



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

Figure 5-8 and Figure 5-9 show the building-type breakdown for commercial potential. Offices account for 45 percent of the economic energy-savings potential (37 percent of economic demand savings potential). Retail, restaurants, and colleges account for the next largest shares of potential.

[6] For this study, low income was defined by customer's participation in low-income programs, which may not align closely with other definitions of low income.

Figure 5-8
Commercial Existing Buildings
Energy-savings Potential by Building Type

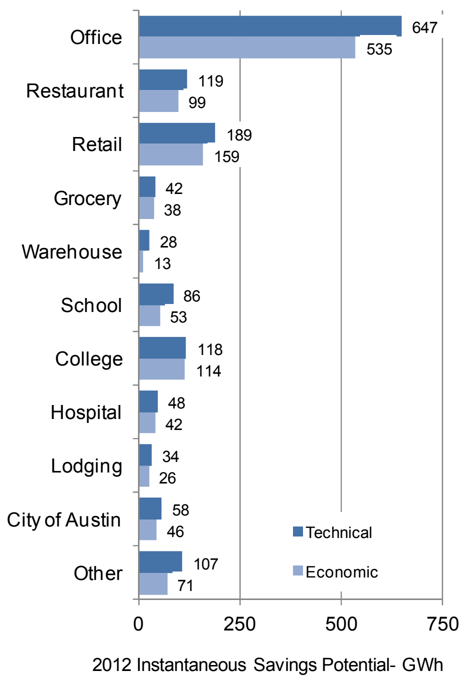
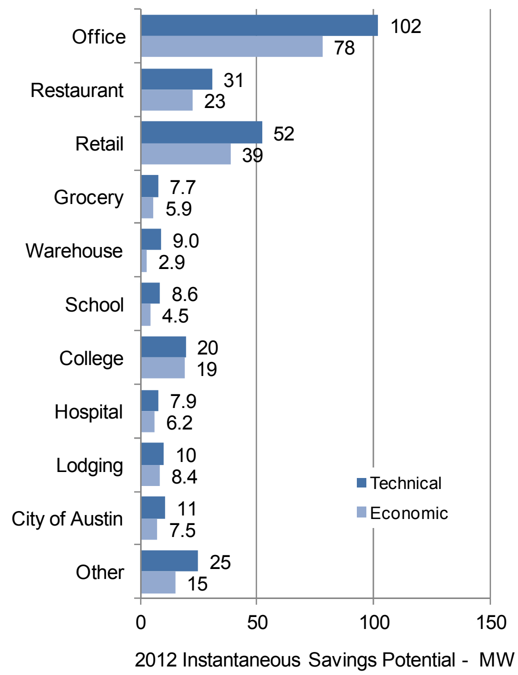


Figure 5-9
Commercial Existing Buildings
Demand-savings Potential by Building Type



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

Figure 5-10 and Figure 5-11 show the business-type breakdown for industrial potential. The electronics industry dominates Austin Energy's industrial sector, which is reflected in the potentials, where electronics accounts for about 69 percent of economic energy potential and 73 percent of economic demand potential. Water/wastewater is a distant second, followed by industrial machinery.

Figure 5-10
Industrial Existing Buildings Energy-savings Potential by Business Type

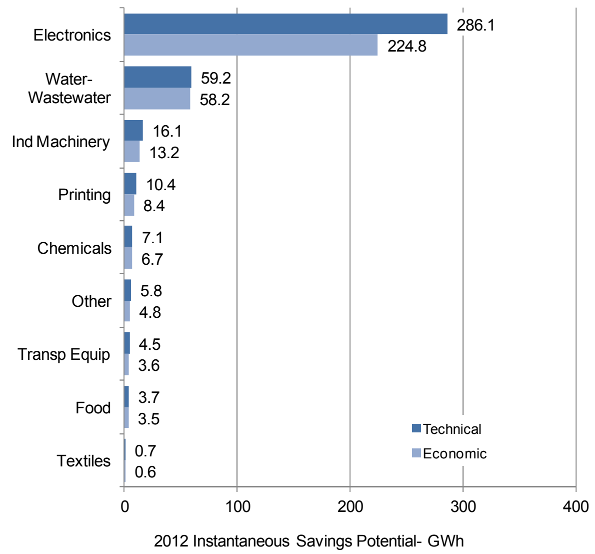
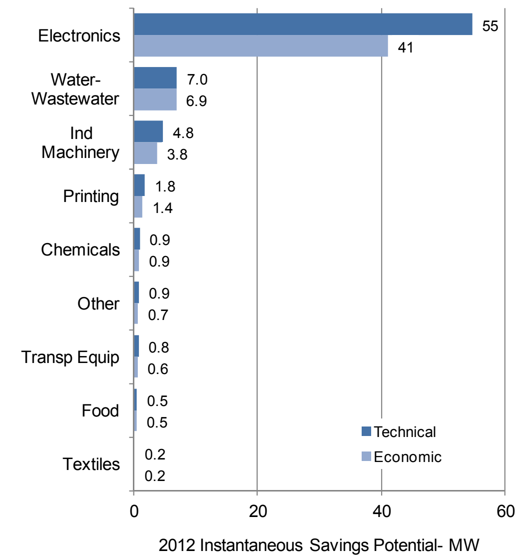


Figure 5-11
Industrial Existing Buildings Demand-savings Potential by Business Type



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

Existing Buildings Potentials by End Use

Figure 5-12 and Figure 5-13 show the end-use breakdown of technical and economic potential in the residential sector. Energy savings potential for existing construction is dominated by cooling, especially for peak demand. In terms of energy savings, cooling is followed by lighting, water heating, and refrigeration. For peak demand, miscellaneous has the second most potential, followed by lighting, water heating, and refrigeration. Miscellaneous has great technical potential but little economic potential.

Figure 5-12
Residential Existing Buildings
Energy-savings Potential by End Use

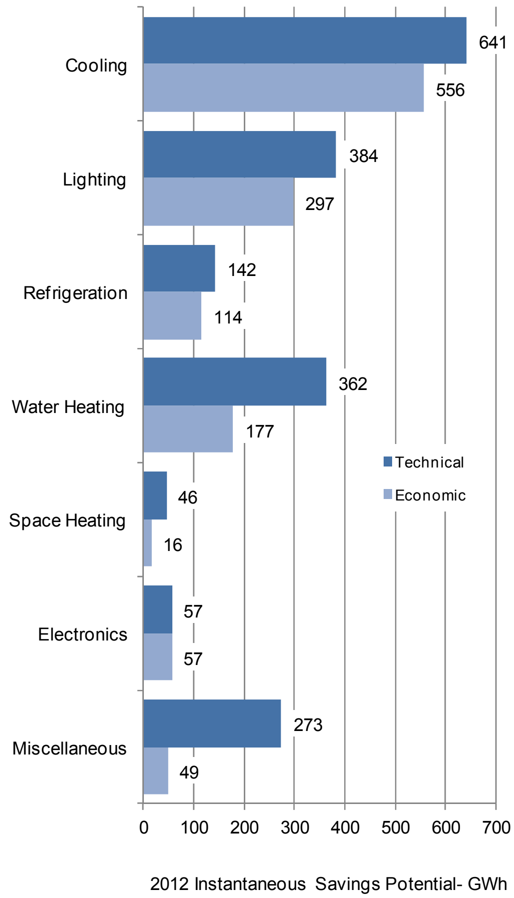
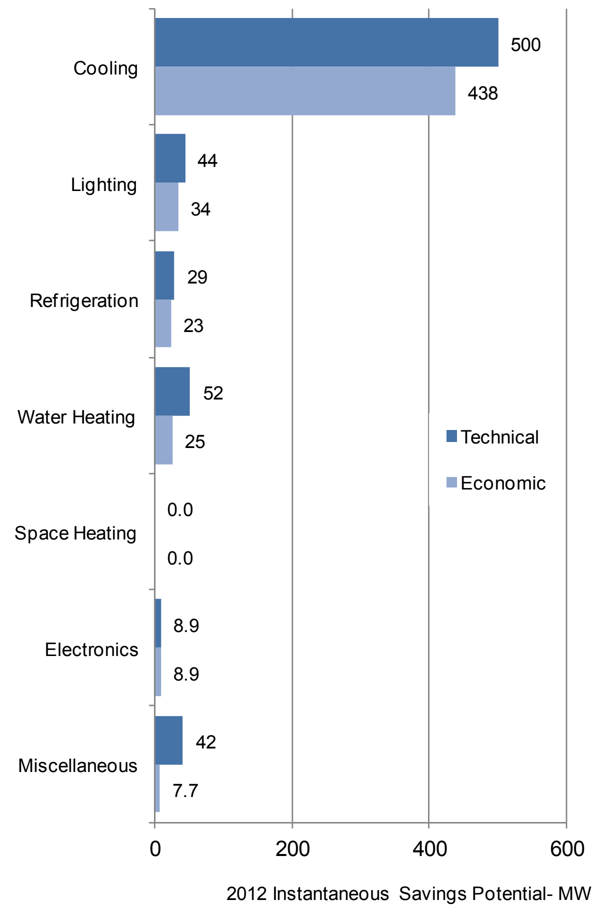


Figure 5-13
Residential Existing Buildings
Demand-savings Potential by End Use



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

Figure 5-14 and Figure 5-15 show the end-use breakdown of commercial potential. The lighting end use is the largest contributor to energy savings potential. For demand potential, space cooling has the greatest technical potential by far. It also has the greatest economic potential, but by a smaller margin than technical, with lighting following closely (indicating that a higher proportion of lighting measures are cost-effective). Despite more stringent upcoming lighting standards, we still expect premium T8 lamps with electronic ballasts and CFLs will remain key lighting measures.

Figure 5-14
Commercial Existing Buildings
Energy-savings Potential by End Use

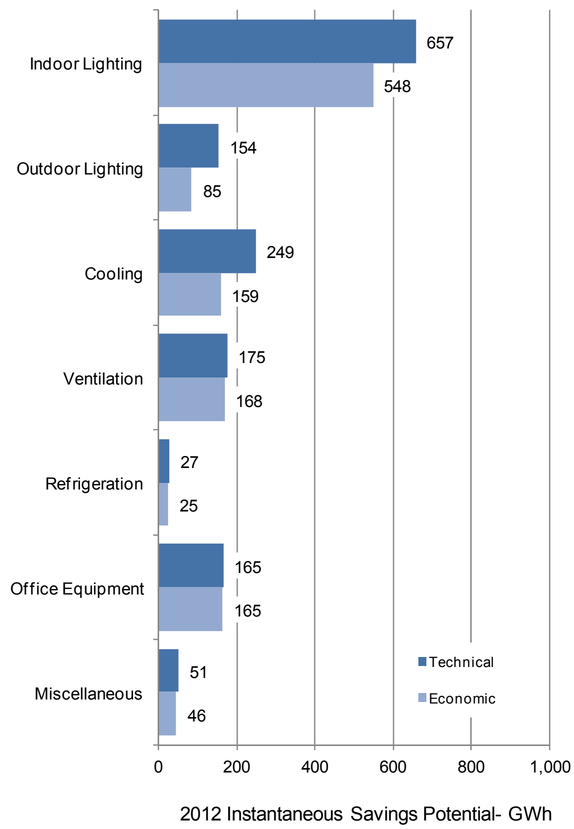
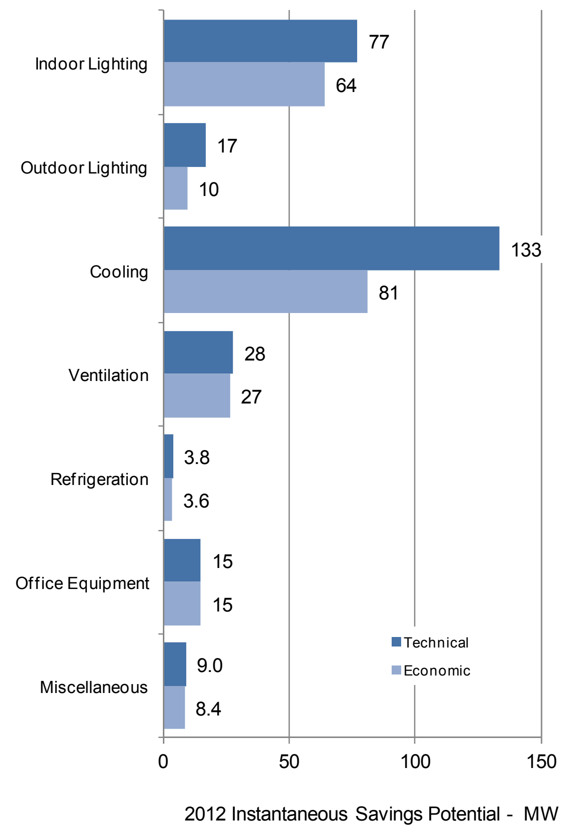


Figure 5-15
Commercial Existing Buildings
Demand-savings Potential by End Use



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

Figure 5-16 and Figure 5-17 show the end-use breakdown of industrial potential. Industrial potential is dominated by cross-cutting measures that are common and similar across all industries and include space cooling, lighting, and motor-based end uses (fans, compressed air, and pumps). These end uses are fairly common and similar across industries, and more is understood about them. Other process end uses (drives, heating, refrigeration, and “other”) are more heterogeneous across industries, often involving more complex technologies and systems, and are therefore more difficult to develop bottom-up potentials savings estimates for. It is possible that our analysis may be conservative on the low side for these less-understood measures.

Figure 5-16
Industrial Existing Buildings
Energy-savings Potential by End Use

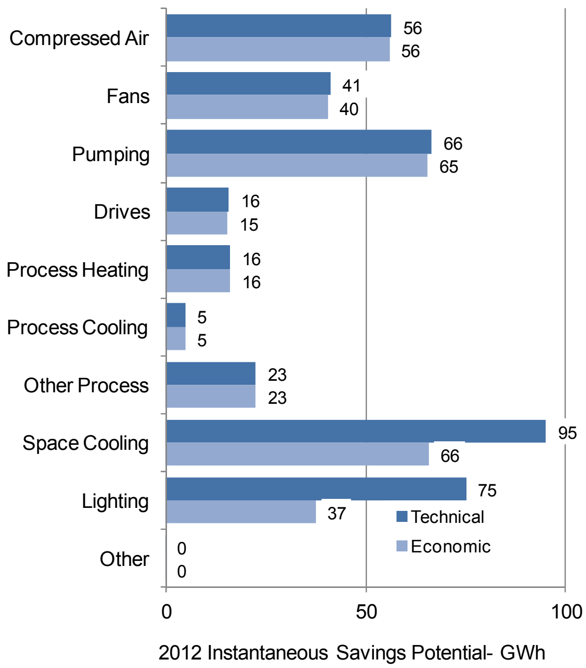
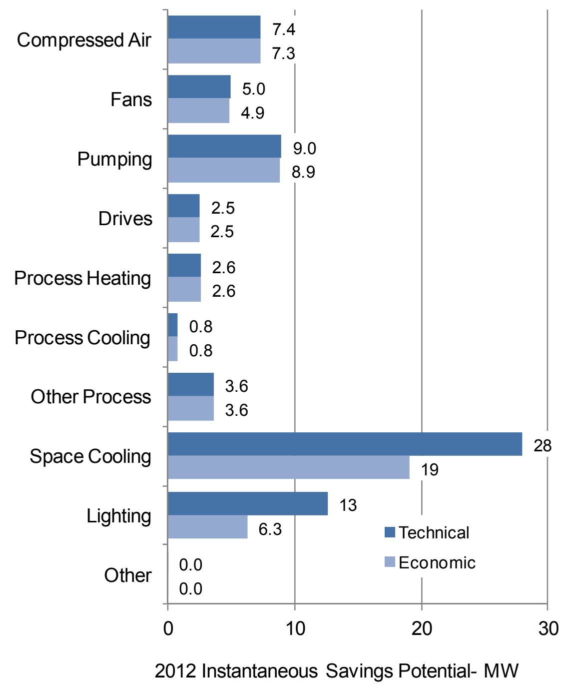


Figure 5-17
Industrial Existing Buildings
Demand-savings Potential by End Use



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spin reserves.

5.1.2.2 Technical and Economic Potential for New Construction

This subsection presents technical and economic potential for one year's worth of new construction. Although the potentials for new construction look small compared to existing construction, it's important to note that by 2020, the building stock will include nine years worth of new construction that could be affected by Austin Energy's new construction programs.

New Construction Potentials by Sector

Figure 5-18 and Figure 5-19 show estimates of technical and economic energy and demand savings potential by sector. Figure 5-20 and Figure 5-21 show the same potentials as a percentage of base energy and base peak demand.

The economic energy savings potential for the residential sector is extremely low, reflecting the stringent new building codes that will save 65 percent over the reference code by 2015. This difference is even more pronounced for peak demand. Non-residential buildings, both commercial and industrial, have significant potential. While aggressive, the upcoming non-residential building codes reach only 30 percent over the reference code. In the industrial sector, process loads are significant and not subject to building codes. Most of the new construction measures are cost-effective, so technical and economic potentials are very close in all sectors.

Figure 5-18
Technical and Economic Potential for New Construction Energy Savings by Sector—GWh per Year

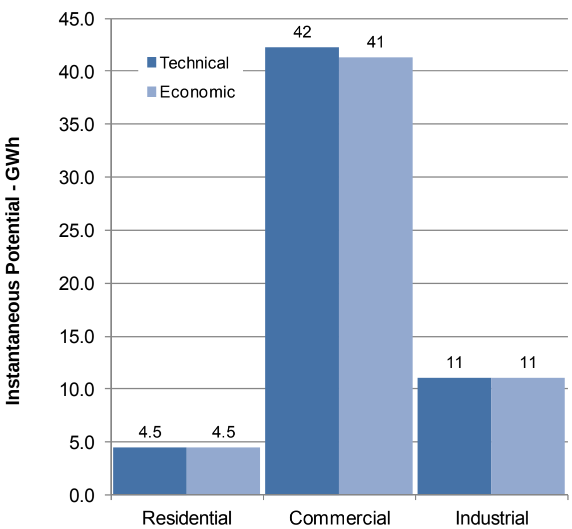
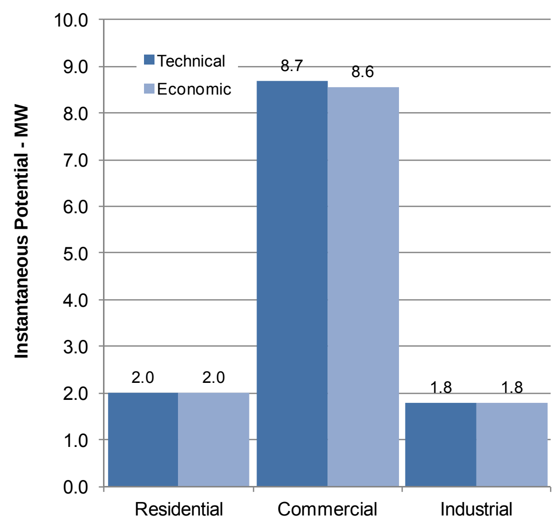


Figure 5-19
Technical and Economic Potential for New Construction Demand Savings by Sector—MW



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spin reserves.

Figure 5-20 and Figure 5-21 show technical and economic potential for new construction as a percentage of base use.

Figure 5-20
Technical and Economic Potential for New Construction Percentage of Base Energy Use

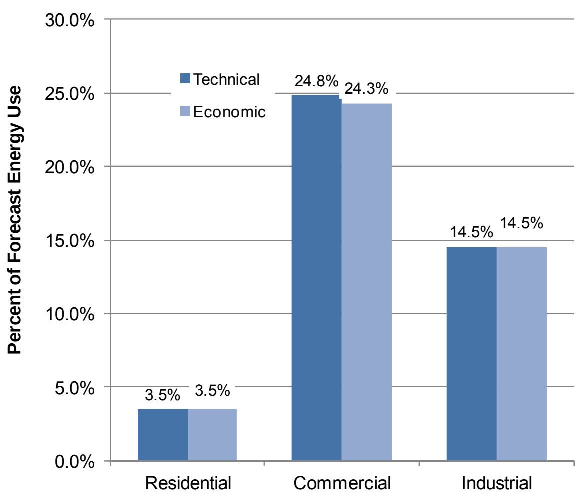
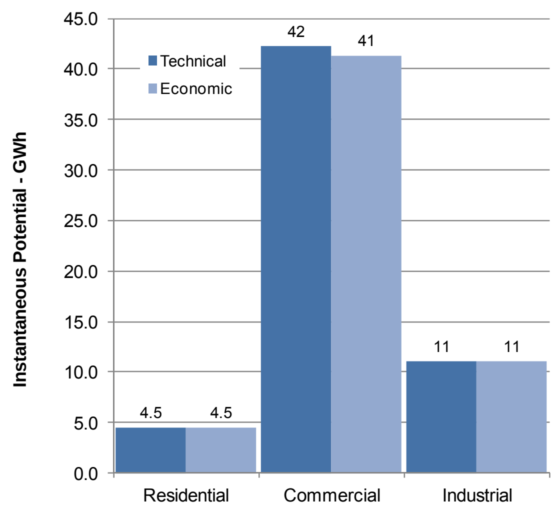


Figure 5-21
Technical and Economic Potential for New Construction Percentage of Base Peak Demand



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

New Construction Potentials by Building Type

Figure 5-22 and Figure 5-23 show the potentials in the residential sector by building type. Single-family homes account for about 71 percent of the economic potential, and low-income homes account for about 3.5 percent of the potential.

Figure 5-22
Residential New Construction Energy-savings Potential by Building Type

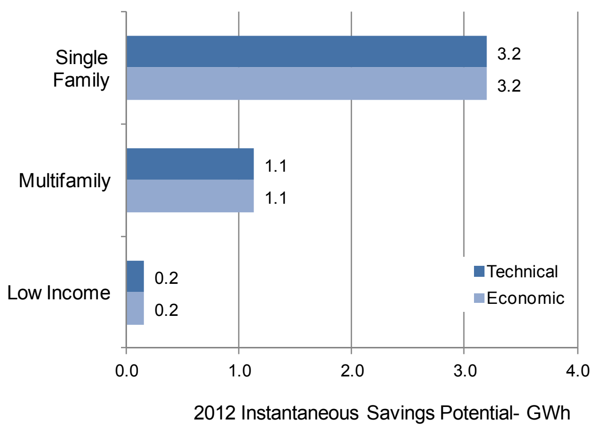
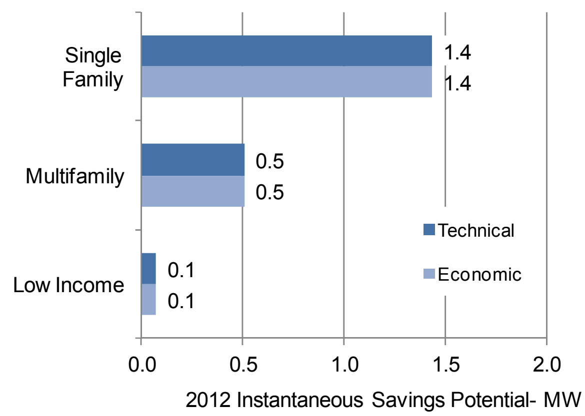


Figure 5-23
Residential New Construction Demand-savings Potential by Building Type



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

Figure 5-24 and Figure 5-25 show the building-type breakdown for commercial potential. Offices account for 41 percent of the economic energy savings potential. The retail and restaurant segments account for the next largest shares of potential.

Figure 5-24
Commercial New Construction
Energy-savings Potential by Building Type

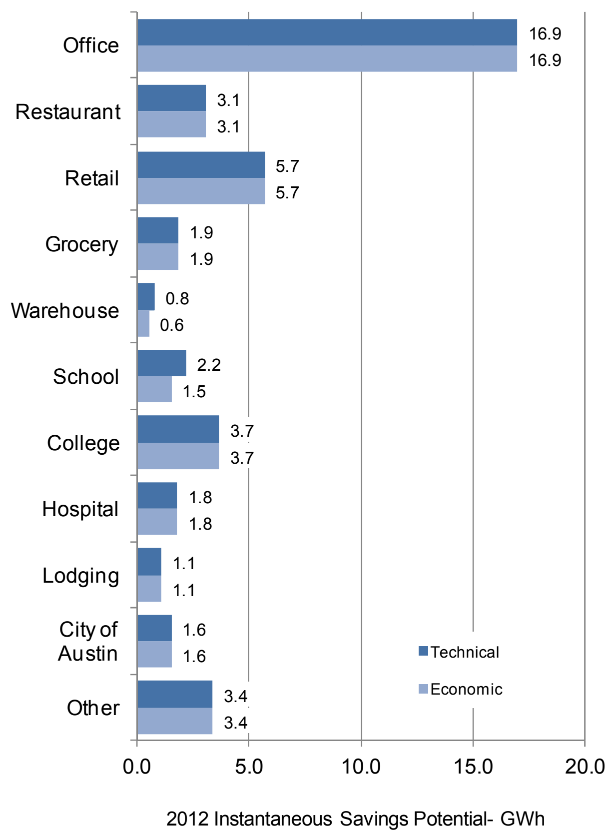
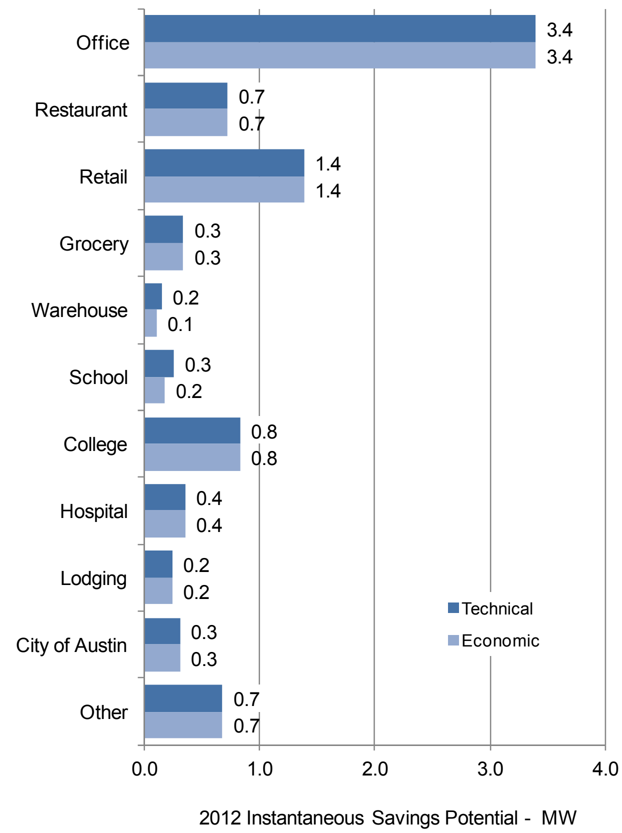


Figure 5-25
Commercial New Construction
Demand-savings Potential by Building Type



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

Figure 5-26 and Figure 5-27 show the building-type breakdown for industrial potential. With a relatively small number of large customers in the industrial sector, there is great uncertainty in this forecast.

Figure 5-26
Industrial New Construction Energy-savings Potential by Building Type

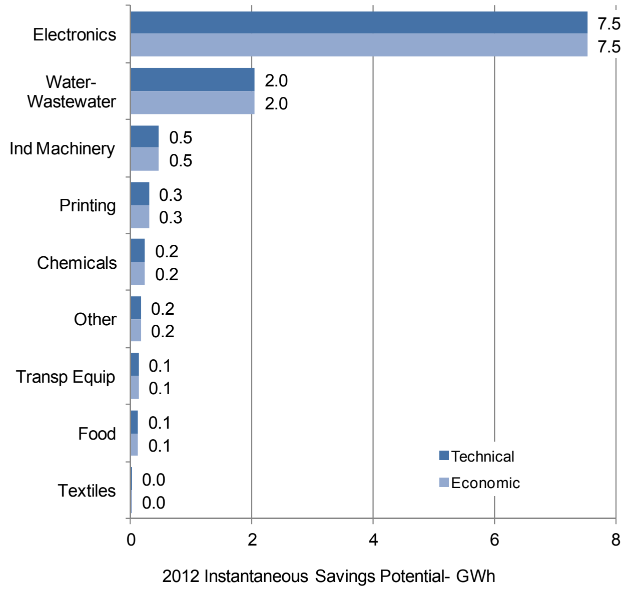
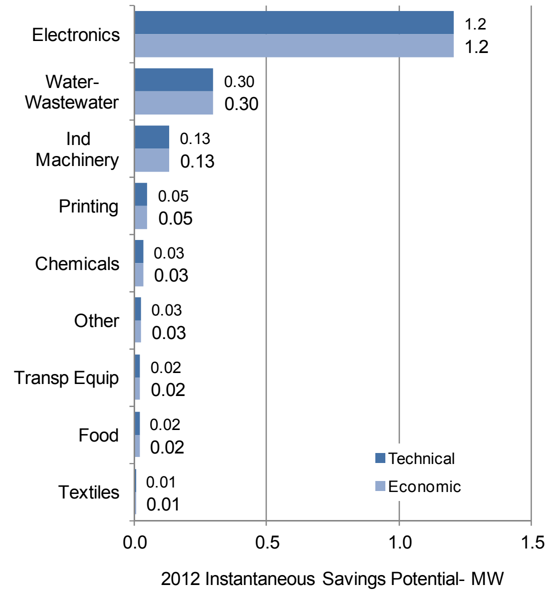


Figure 5-27
Industrial New Construction Demand-savings Potential by Building Type



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spinning reserves.

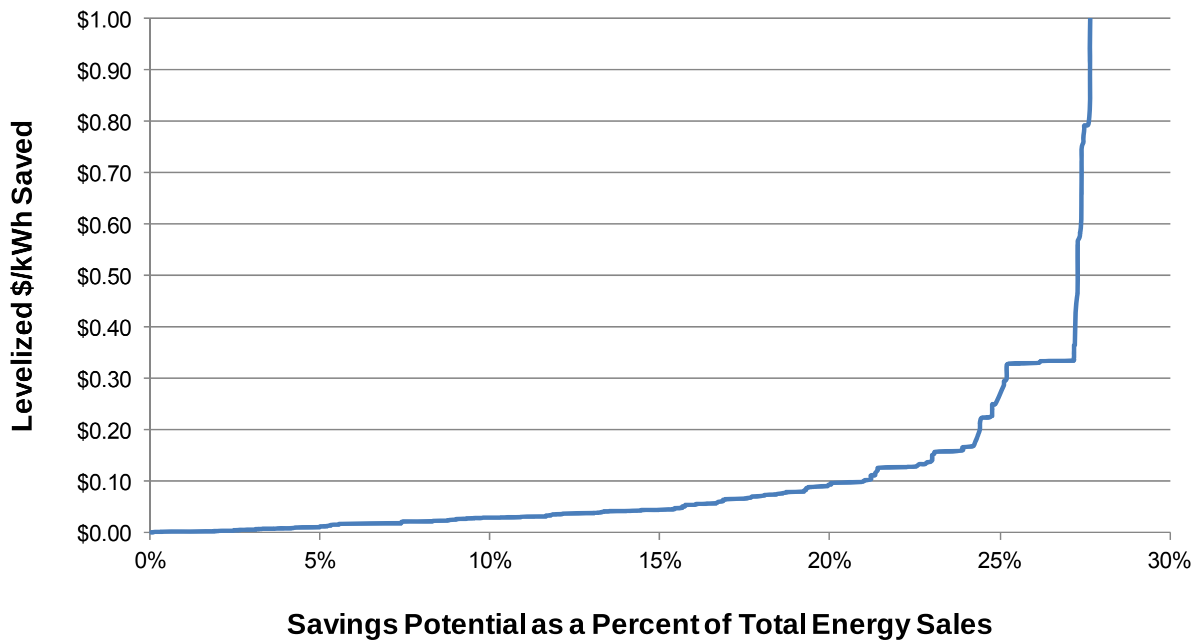
5.1.3 Energy Efficiency Supply Curves

A common way to illustrate the amount of energy savings per dollar spent is to construct an energy efficiency supply curve. A supply curve is typically depicted on two axes: one captures the cost per unit of saved energy (e.g., levelized $/kWh saved), and the other shows energy savings at each level of cost. Measures are sorted on a least-cost basis, and total savings are calculated incrementally with respect to measures that precede them. The costs of the measures are levelized over the life of the savings achieved.

Figure 5-28 and Figure 5-29 present the supply curves constructed for electric energy efficiency and peak-demand efficiency, respectively, for this study. To represent new construction and existing building measures on the same chart for savings potential through 2020, we applied a decay factor to the existing buildings potential to represent the effects of the building decay rate (assumed to be 0.5 percent for commercial buildings and 1 percent for residential buildings), and multiplied new construction potential by nine to account for the nine program years of new construction between 2012 and 2020.

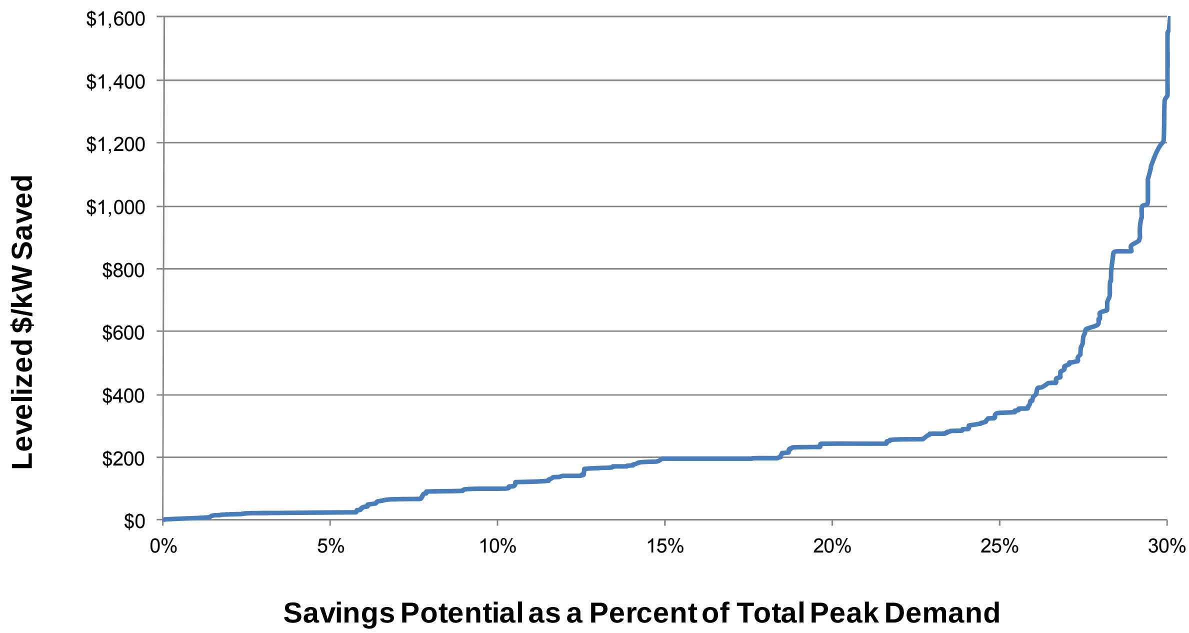
Each curve represents savings as a percentage of total energy or peak demand. These curves show that about 16 percent of energy savings are available at under $0.05 per kWh, and about 9 percent of peak demand savings are available at under $100 per kW. Savings potentials and levelized costs for the individual measures that comprise the supply curves are provided in Appendix G.

Figure 5-28
Electric Energy Supply Curve*



*Levelized cost per kWh saved was calculated using a 4 percent nominal discount rate.

Figure 5-29
Peak-demand Supply Curve*



*Levelized cost per kW saved was calculated using a 4 percent nominal discount rate. This includes 20 percent for transmission and distribution losses and spinning reserve.

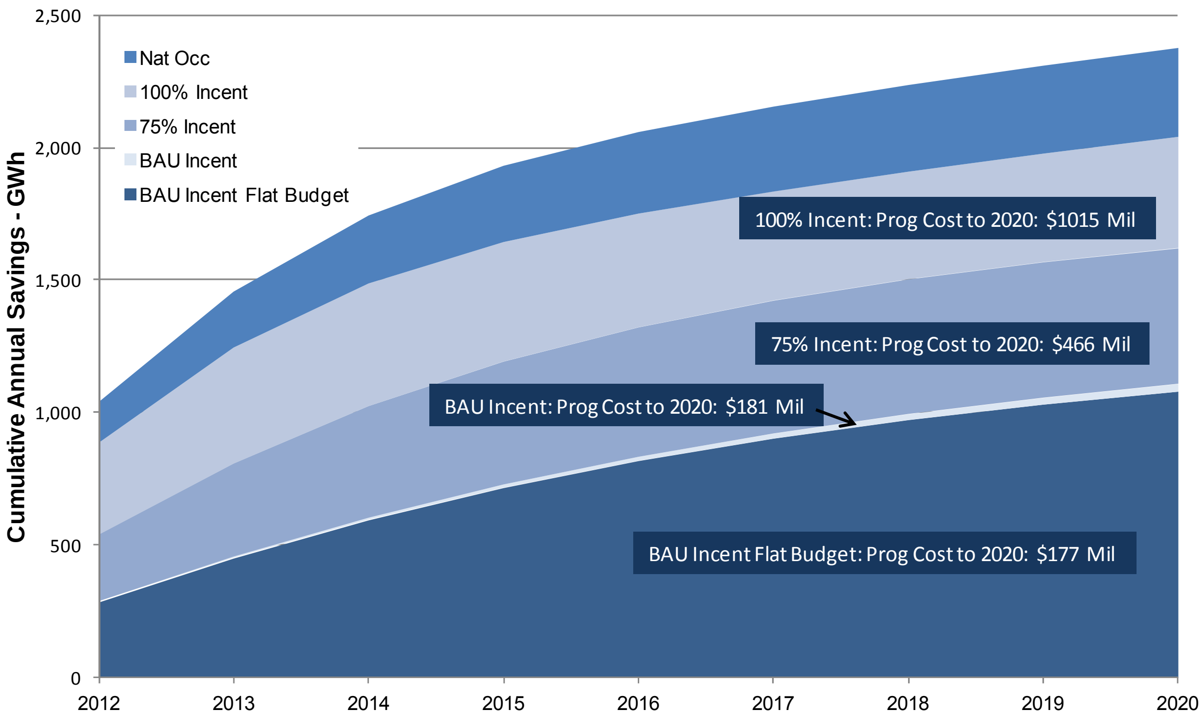
5.2 Achievable (Program) Potential

In contrast to technical and economic potential estimates, achievable potential estimates consider market and other factors that affect efficiency measure adoption. Our method of estimating measure adoption considers market barriers and reflects actual consumer- and business-implicit discount rates. This section presents results for achievable potential, first at the summary level and then by sector. More detail on achievable program potential is shown in Appendix H.

Achievable potential refers to the amount of savings that would occur in response to one or more specific program interventions. These are savings that are projected beyond those that would occur naturally in the absence of any market intervention. Because achievable potential depends on the type and degree of intervention applied, we developed potential estimates under alternative funding scenarios: BAU incentives with flat budgets (no inflation adjustment), BAU incentives (with inflation adjustment), 75-percent incentives, and 100-percent incentives. These scenarios reflect the percentage of incremental measure cost that is assumed to be paid in customer incentives. For the BAU case, program marketing and administration costs were increased at the rate of inflation. For the BAU case with no inflation adjustment, marketing and administration budgets were kept flat. For the 75-percent and 100-percent scenarios, marketing budgets were kept at the BAU levels (with inflation adjustments), and administrative budgets were increased to account for increased participation. We estimated program energy and peak-demand savings under each scenario for the 2012–2020 period.

Figure 5-30 shows our estimates of achievable potential energy savings over time (peak demand savings follow a similar pattern). As shown in Figure 5-30, by 2020, cumulative program energy savings are projected to be 1,108 GWh under the BAU scenario (1,080 GWh for BAU with flat budgets), 1,620 GWh under the 75-percent incentive scenario, and 2,039 GWh under the 100-percent incentive scenario. (Program costs increase substantially by moving to higher incentive scenarios as the analysis the need to increase incentives to capture additional potential but also having to pay all other customers the higher incentives as well.)

Figure 5-30
Achievable Electric Energy-Savings: All Sectors



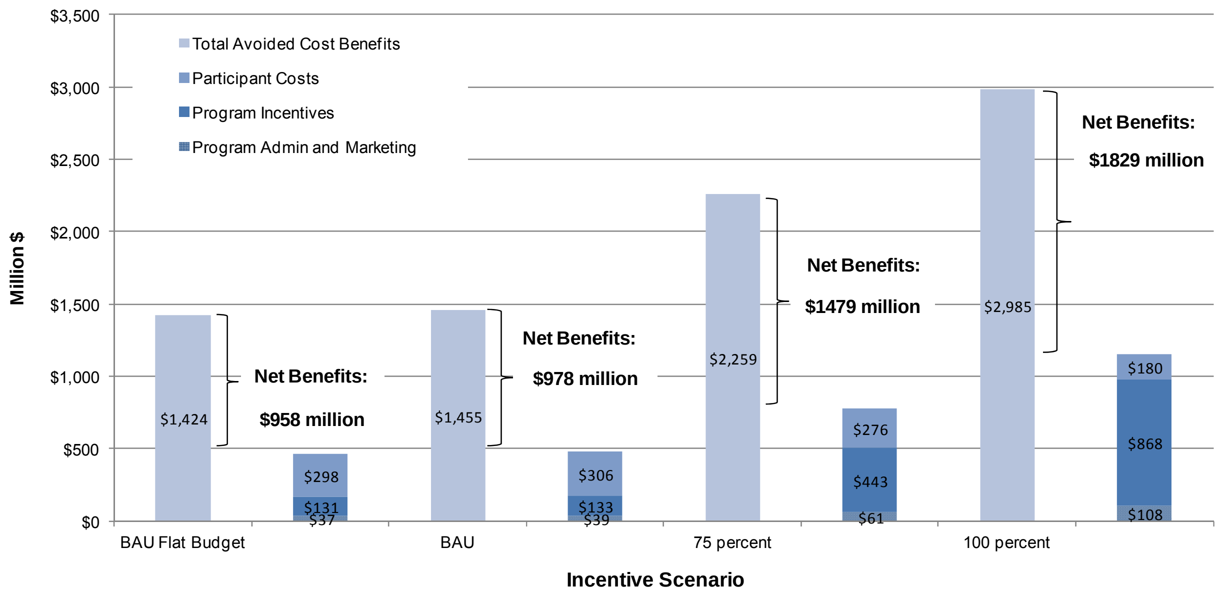
Energy forecast includes 7% transmission and distribution losses.

Figure 5-30 also shows that the increase in cumulative savings declines over time. This result occurs because retrofit measures (measures that are not dependent on equipment turnover cycles and can be added at any time) begin reaching high saturations over time, and it becomes more difficult to capture additional savings as the retrofit opportunities diminish (emerging technologies may create new opportunities, but the model only captures currently commercially available technologies). In Austin, the decline is exacerbated by the upcoming revisions to building codes, which leave less opportunity for energy-efficiency programs.

While the decline in additional savings is fairly modest in the BAU scenario, it is more pronounced in the higher incentive cases. For the 100-percent incentive scenario, savings accumulate rapidly during the first few years of the forecast horizon, but then flatten out considerably thereafter. This can be perceived as a boom-bust phenomenon – where a program ramps up dramatically over a few years, and then must be scaled back significantly afterwards as program participation declines due to high saturation levels. While the high incentive scenario may lead to front-loaded energy savings (a good thing), it could lead to dramatically reduced program effort and funding in later years, which may affect the program's ability to evolve and continue to capture emerging opportunities.

Figure 5-31 depicts costs and benefits under each funding scenario from 2012 to 2020. The present value of program costs (including administration, marketing, and incentives) is $172 million under the BAU scenario ($167 million if budgets are kept flat), $504 million under the 75-percent incentive scenario, and $976 million under the 100-percent incentive scenario. The present value of total avoided-cost benefits is $1,455 million under the BAU scenario ($1,424 million if budgets are kept flat), $2,259 million under 75-percent incentives, and $2,985 million under 100-percent incentives. The present value of *net* avoided-cost benefits, i.e., the difference between total avoided-cost benefits and total costs (which include participant costs in addition to program costs), is $978 million under BAU ($958 million if budgets are kept flat), $1,479 million under 75-percent incentives, and $1,829 million under 100-percent incentives. (Note, there are participant costs in the 100-percent incentive scenario because some measures are included as education only (no incentives) even in the 100 percent scenario case, and because the DSM Assyst model assumes measures initially purchased with program incentives are repurchased without program incentives if then burn out during the forecast period.)

Figure 5-31
Benefits and Costs of Energy Efficiency Savings—2012-2020*



* PV (present value) of benefits and costs is calculated for 2012-2020 program years using a nominal discount rate = 4 percent, and an assumed inflation rate = 2.5 percent.

All four of the funding scenarios are cost-effective based on the TRC test, which is the test used in this study to determine program cost-effectiveness. The TRC benefit-cost ratios are 3.05 for the BAU, 3.06 for BAU with flat budgets, 2.90 for the 75-percent incentive scenario, and 2.58 for the 100-percent incentive scenario. This indicates that program cost-effectiveness declines somewhat with increasing program effort, reflecting penetration of more measures with lower cost-effectiveness levels. Key results of our efficiency scenario forecasts from 2012 to 2020 are summarized in Table 5-1.

Table 5-1
Summary of Achievable Potential Results—2012–2020

Result - Programs	Program Scenario: BAU Incentives Flat Budget	BAU Incentives	75 percent Incentives	100 percent Incentives
Total Market Energy Savings - GWh	1,458	1,482	1,932	2,307
Total Market Peak Demand Savings - MW	291	295	422	541
Program Energy Savings - GWh	1,030	1,056	1,567	1,975
Program Peak Demand Savings - MW	226	231	366	492
Program Costs - Real, $ Million				
Administration	$19	$19	$41	$89
Marketing	$20	$22	$23	$24
Incentives	$138	$140	$466	$902
Total	$177	$181	$530	$1,015
PV Avoided Costs	$1,424	$1,455	$2,259	$2,985
PV Annual Program Costs (Adm/Mkt)	$37	$39	$61	$108
PV Net Measure Costs	$429	$439	$719	$1,048
Net Benefits	$958	$978	$1,479	$1,829
TRC Ratio	3.06	3.05	2.90	2.58

PV (present value) of benefits and costs is calculated for 2012-2020 program years using a nominal discount rate = 4 percent, and an assumed inflation rate = 2.5 percent; GWh and MW savings are cumulative through 2020. Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spin reserves.

5.2.1 Breakdown of Achievable Potential

Cumulative net achievable potential estimates by customer class for the period of 2012-2020 are presented in Figure 5-32 and Figure 5-33. These figures show results for each funding scenario. Under the program assumptions developed for this study, achievable energy savings are highest for the commercial sector. Residential peak-demand savings are highest in all the funding scenarios. Savings increase with higher levels of funding and higher incentives for all sectors.

Figure 5-32
Achievable Energy Savings (2020) by Sector—GWh per Year

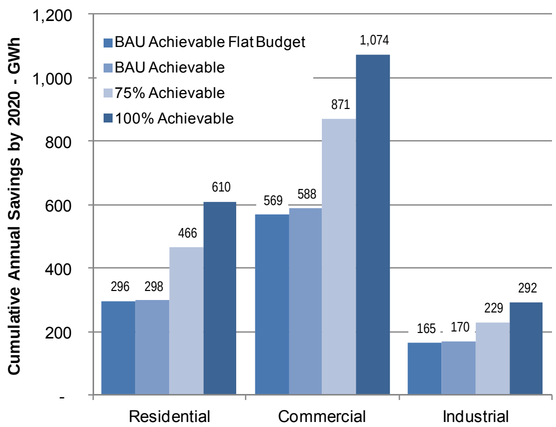
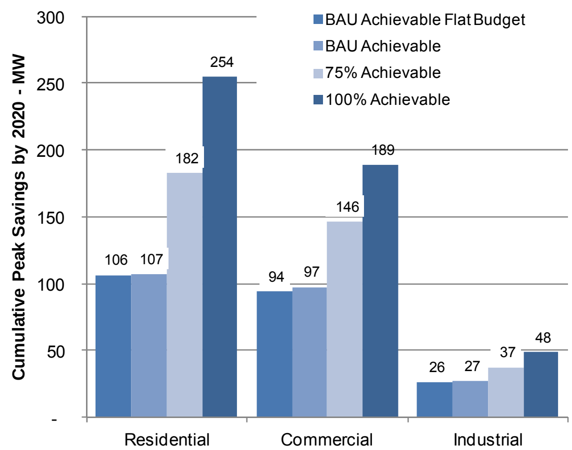


Figure 5-33
Achievable Peak-Demand Savings (2020) by Sector—MW



Note: Energy forecast includes 7% transmission and distribution losses. Demand forecast includes 20% for transmission and distribution and spin reserves.

Table 5-2 and Table 5-3 show similar information as the previous figures, but also compare potentials to 2020 base energy use. Overall, achievable energy savings potentials range between 7 percent of base use for the BAU flat budget scenario (the equivalent of about 0.8 percent savings per year to 13.5 percent of base use for the 100-percent incentive scenario (equating to about 1.5 percent savings per year). Achievable residential energy savings potentials range between 5.9 percent and 12 percent of base usage, with commercial potentials ranging between 9.7 percent and 18 percent of base use, and industrial potentials ranging between 6.2 percent and 11 percent of base use.

Total achievable demand savings range between 6.8 percent of peak demand for the BAU flat budget scenario and 15 percent of peak demand for the 100-percent incentive scenario. The residential sector shows the widest range in demand savings relative to base demand, with less variation between scenarios for the commercial and industrial sectors.

Table 5-2
Achievable Energy Savings (2020) by Sector– GWh per Year

Sector	2020 Base Energy Use (GWH)	Cumulative Potential in 2020- GWh			
		BAU Achievable (Program) Flat Budget	BAU Achievable (Program)	75% Achievable (Program)	100% Achievable (Program)
Residential	5,041	296	298	466	610
Savings % of Base		**5.9%**	**5.9%**	**9.2%**	**12%**
Commercial	5,844	569	588	871	1,074
Savings % of Base		**9.7%**	**10.1%**	**14.9%**	**18.4%**
Industrial	2,658	165	170	229	292
Savings % of Base		**6.2%**	**6.4%**	**8.6%**	**11.0%**
Total	14,635	1,030	1,056	1,567	1,975
Savings % of Base		**7.0%**	**7.2%**	**10.7%**	**13.5%**

Note: Energy forecast includes 7% transmission and distribution losses.

Table 5-3
Achievable Demand Savings (2020) by Sector – MW

Sector	2020 Base Demand (MW)	Cumulative Potential in 2020- MW			
		BAU Achievable (Program) Flat Budget	BAU Achievable (Program)	75% Achievable (Program)	100% Achievable (Program)
Residential	1,321	106	107	182	254
Savings % of Base		**8.1%**	**8.1%**	**13.8%**	**19.3%**
Commercial	1,317	94	97	146	189
Savings % of Base		**7.1%**	**7.4%**	**11.1%**	**14.3%**
Industrial	462	26	27	37	48
Savings % of Base		**5.7%**	**5.8%**	**8.1%**	**10.5%**
Total	3,323	226	231	366	492
Savings % of Base		**6.8%**	**7.0%**	**11.0%**	**14.8%**

Note: Demand forecast includes 20% for transmission and distribution and spin reserves.

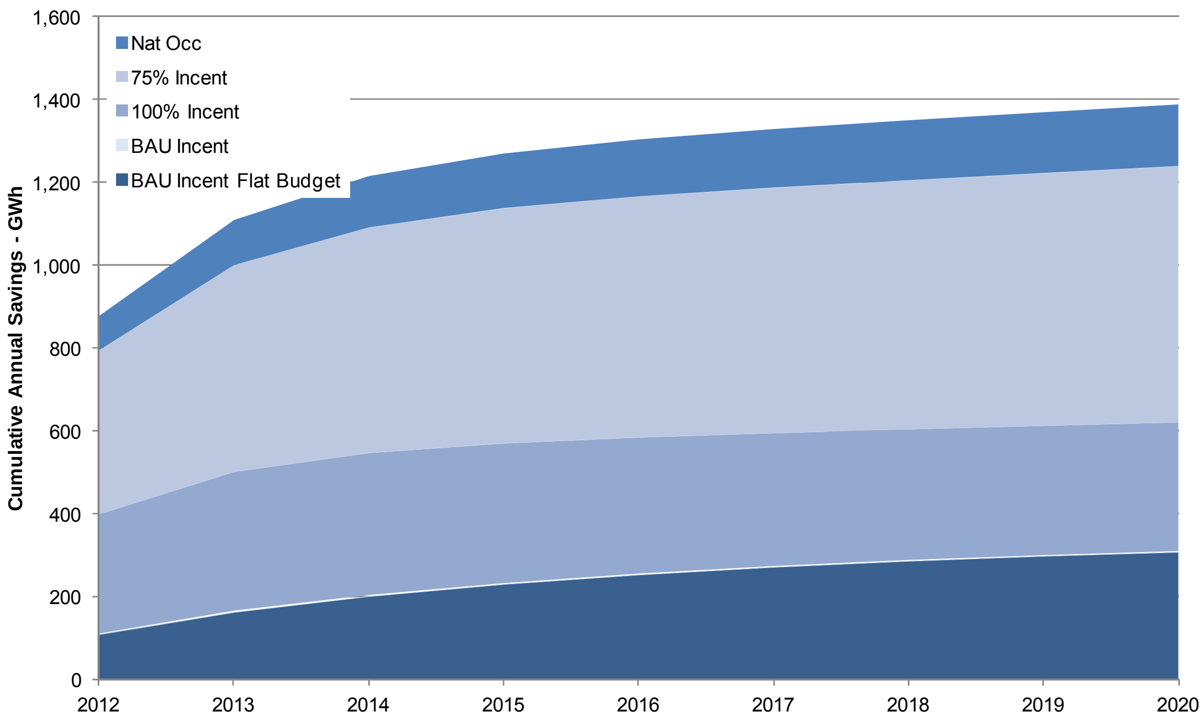
5.2.1.1 Residential Sector

Figure 5-34 shows cumulative net achievable program energy savings by program scenario for the residential sector. (Demand savings show a similar yearly pattern.) By 2020, net energy savings reach 307 GWh under the BAU scenario (306 with flat budgets), 474 GWh under the

75-percent incentive scenario, and 619 GWh under the 100-percent incentive scenario. Energy savings are most sensitive to changes in incentives in the 75- to 100-percent range.

The forecast shows a marked flattening after the first few years due to the 2015 building codes, which capture much of the savings potential in the residential sector, leaving less available for energy-efficiency programs.

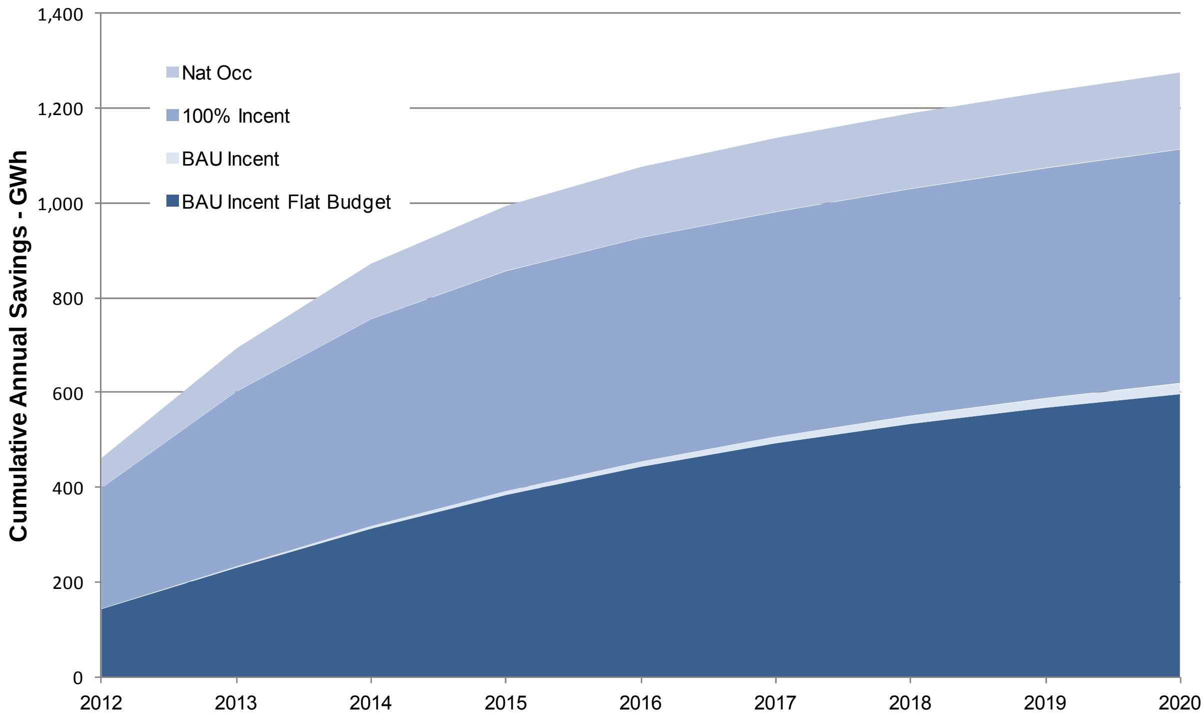
Figure 5-34
Achievable Energy Savings: Residential Sector



5.2.1.2 Commercial Sector

Figure 5-35 shows cumulative net achievable program savings by commercial program scenario. By 2020, achievable energy savings reach 620 GWh under the BAU scenario (598 GWh if budgets are kept flat), 905 GWh under the 75-percent incentive scenario, and 1,113 GWh under the 100-percent incentive scenario. Growth in savings levels off considerably after the first few years in both the 75-percent incentive scenario and the 100-percent incentive scenario.

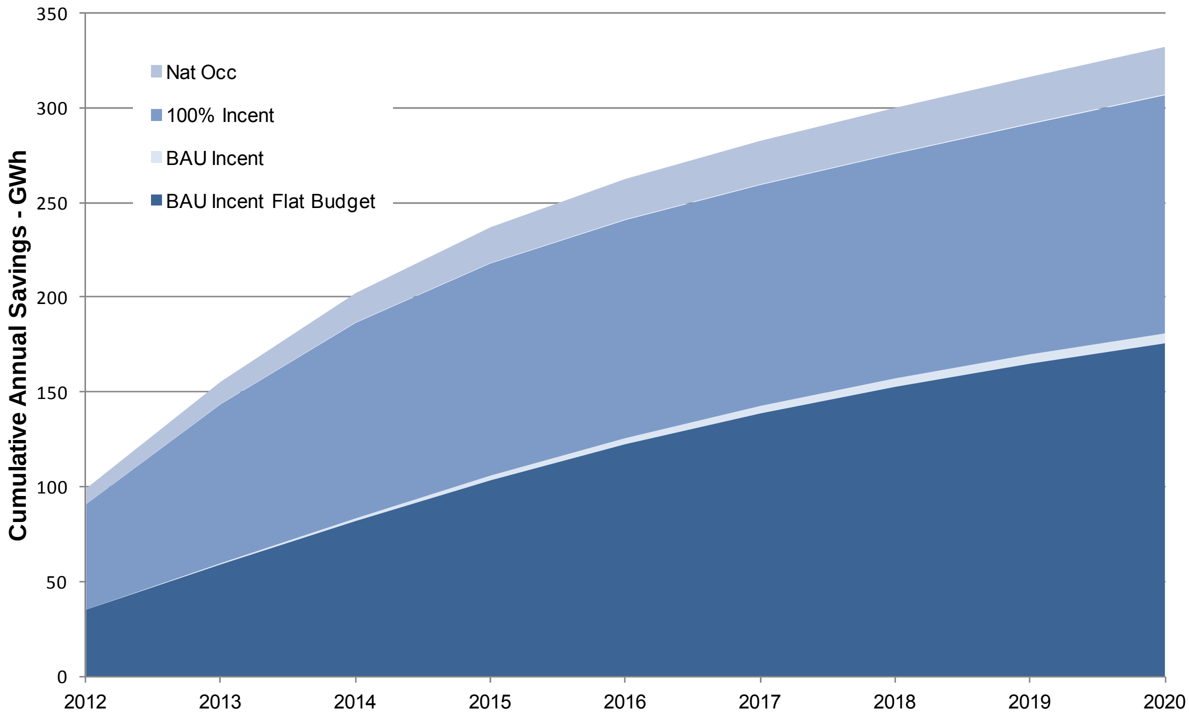
Figure 5-35
Achievable Energy Savings: Commercial Sector



5.2.1.3 Industrial Sector

Figure 5-36 shows cumulative net achievable program savings by industrial program scenario. By 2020, energy savings reach 181 GWh under the BAU scenario (176 if budgets are kept flat), 241 GWh under the 75-percent incentive scenario, and 307 GWh under the 100-percent incentive scenario.

Figure 5-36
Achievable Energy Savings: Industrial Sector



5.3 Potential Savings in Context

It is important to understand the DNV KEMA potential estimates in the context of Austin Energy's portfolio of demand-side management (DSM) programs and its current consumption and savings forecasts. Table 5-4 compares the BAU achievable results from the previous section with Austin Energy's demand savings forecast.

Austin Energy's forecast achieves 800 MW of saving from 2007 to 2020, which is its Climate Protection Plan goal. Program efforts from 2007 to 2011 have already achieved 269 MW, leaving 531 MW to be captured through current and future DSM efforts. Of that 531 MW, Austin Energy expects 295 MW to be captured through energy-efficiency programs.

To compare the results of the potential study with the Austin Energy forecast, recall that this study only estimates potential for energy efficiency measures, not building codes or load management. The effect of Austin Energy's building code and load management programs were accounted for in DNV KEMA's 2020 baseline forecast (see section 4.6). Table 5-4 shows Austin

Energy's no-DSM forecast of 2020 demand, forecasted code and load management savings, and the baseline used for the current analysis. Since this report did not analyze codes or load management, these values are the same for both the DNV KEMA analysis and the Austin Energy Forecast. The table then shows the breakout of DNV KEMA's base forecast by sector, and the potentials estimated for the business-as-usual program scenario (program budgets and incentive levels kept at current levels with adjustments for inflation).

DNV KEMA estimated a BAU savings potential by 2020 of 231 MW, compared to 295 MW in Austin Energy's forecast, a difference of 64 MW (22 percent of Austin Energy's energy-efficiency forecast and 12 percent of its total DSM portfolio forecast of 531 MW). This result suggests that meeting that MW goal, and therefore the Climate Protection Plan goal of 800 MW, may be difficult or impossible with current program budgets and incentive levels.

Table 5-5 shows the potential results for the technical and economic analyses and all four program scenarios. For ease of comparison between technical and economic potential and achievable potential, the existing building and new construction technical and economic potentials have been combined using the weighting approach described in section 4.6, applying a decay factor to existing building savings and a growth factor to new construction to estimate these potentials in 2020. All of the potentials are compared to the 2020 baseline used for reporting achievable potentials. We also show the 9-year achievable potentials as a percent of both technical and economic potential.

For comparison with the Austin Energy forecasts, Table 5-5 also shows Austin Energy's load management and building code savings forecasts. The last two rows add these to the DNV KEMA potential estimates, and show the savings as a percent of Austin's no-DSM demand forecast. While the BAU scenario left Austin Energy 12 percent short of its 800 MW 2020 goal, the potential for the 75 percent incentive scenario is 13 percent higher than the 531 MW Austin Energy needs to meet the goal. The 75 percent incentive scenario represents a significantly higher program cost, however: an average annual program cost of $59 million compared to $20 million for the BAU scenario.

Table 5-4
Comparison of BAU Potential Forecast and Austin Energy's Demand Savings Forecast

	DNV KEMA Forecast				Austin Energy Forecast		
	No DSM Base Load MW	DNV KEMA Base Forecast MW	DNV KEMA BAU Savings MW	Net Demand BAU MW	No DSM Base Load MW	Austin Savings MW	Net Demand MW
Base Case (No DSM)	**3,963**				**3,963**		
Building Code Total			154			154	
Load Management Total			82			82	
Total Out-of-analysis AE Program			**236**			**236**	
Baseline for DNV KEMA Analysis		**3,727**					**3,727**
Residential Total		1,482	107	1,375			
Commercial Total		1,477	97	1,380			
Industrial Total		518	27	491			
Other Total		250	0	250			
All Sectors Total		**3,727**	**231**	**3,496**		**295**	**3,432**
Savings % of DNV KEMA Base			6.2%			7.9%	
Savings % of Austin No-DSM Base			5.8%			7.4%	
Total DSM (in and out of DNV KEMA analysis)			**467**			**531**	
Savings % of Austin No-DSM Base			11.8%			13%	

Note: Demand forecast includes 20% for transmission and distribution and spin reserves.

Table 5-5
Summary of Demand Savings Potentials for Austin Energy

	No DSM Base Load 2020	DNV KEMA 2020 Base Forecast	Technical Potential	Economic Potential	Achievable Potentials			
					BAU Flat Budget	BAU	75 Percent Incentives	100 Percent Incentives
Austin Energy Base Case (No DSM)	3,963							
Total Out-of-analysis AE Program (same for all scenarios)			236	236	236	236	236	236
Residential Total		1,482	636	509	106	107	182	254
Commercial Total		1,477	349	276	94	97	146	189
Industrial Total		518	84	70	26	27	37	48
Other Total		250	0	0	0	0	0	0
All Sectors Total		3,727	956	744	226	231	366	492
Savings % of DNV KEMA Base			25.7%	20.0%	6.1%	6.2%	9.8%	13.2%
Savings % of Austin No-DSM Base			24.1%	18.8%	5.7%	5.8%	9.2%	12.4%
Savings % of Economic Potential					23.7%	24.2%	38.2%	51.4%
Total DSM (in and out of DNV KEMA analysis)			1,192	980	462	467	602	727
Savings % of Austin No-DSM Base			30.1%	24.7%	11.7%	11.8%	15.2%	18.4%

Note: Demand forecast includes 20% for transmission and distribution and spin reserves.